RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Diagnosis of Congenital Heart Disease by Ordinary Methods[1]

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THE CORRECT differential diagnosis of congenital heart disease depends on fundamental knowledge of cardiac physiology. Practical clinical experience and efficient radiological assistance are equally important. In the past few years, newer and more involved technics, such as angiocardiography and catheterization of the heart, have been introduced as aids in diagnosis. It is the purpose of this discussion to emphasize the fact that in the great majority of cases a precise diagnosis can be made by the usual methods. The newer procedures are difficult and expensive; they require the efforts of several experts, are uncomfortable and sometimes dangerous to the patient, and are available only in larger medical centers. They are necessary only in unusual and complicated cases. From my own experience, this should include not more than 15 to 20 per cent of all patients with congenital cardiac anomalies. Clinicians frequently feel the need of the newer diagnostic procedures because of their inadequate experience with congenital heart disease.

It is significant that while many hundreds of patients with congenital heart lesions have been operated upon, few errors in diagnosis have been made, despite the fact that practically none of the cases have had the advantage of angiocardiography and/or catheterization. Our own experience includes operations upon considerably more than 100 patients with patent ductus arteriosus, several with coarctation of the aorta, and about 60 with cyanotic congenital heart disease, and in only one instance are we aware of an error in diagnosis. None of our patients has been studied with the newer methods. All of this is stated with the full knowledge of the tremendous value of angiocardiography and catheterization. These technics are not only invaluable in the differentiation of congenital heart disease, where indicated, but they have already provided us with increasing knowledge concerning the physiology of the circulation as well as more exact knowledge of the roentgen anatomy of the heart. However, they must not and cannot be used promiscuously.

It has seemed of value to present the major findings in the more typical anomalies of the heart. It is hoped that such a review will aid the roentgenologist in interpreting the x-ray findings, thereby assisting the clinician in making a correct diagnosis. This should obviate the necessity for frequent use of the more difficult and complicated diagnostic procedures.

For practical purposes, congential anom-

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alies of the heart may be divided into two main groups, namely, those with and those without cyanosis. The lesions in which a precise diagnosis can be made and those which are of more practical importance are listed below.

Lesions Without Cyanosis

1. Subaortic stenosis
2. Anomalies of the aortic arch
3. Coarctation of the aorta
4. Patent interventricular septum
5. Patent interauricular septum
6. Patent ductus arteriosus
7. Dextrocardia with situs transversus

Lesions with Cyanosis

1. Tetralogy of Fallot
2. Tricuspid atresia with underdeveloped right ventricle
3. Eisenmenger's complex
4. Pulmonary stenosis
5. Transposition of the greater vessels
6. Truncus arteriosus

SUBAORTIC STENOSIS

Subaortic stenosis is a relatively rare lesion. It results from a developmental narrowing of the root of the aorta proximal to the valve. Occasionally this lesion is accompanied by stenosis of the aortic valve itself. The clinical findings are similar to those in rheumatic aortic stenosis. However, a history of a heart murmur from birth or early infancy with no history of rheumatic fever suggests a congenital lesion. A prolonged harsh murmur, heard best over the aortic area and transmitted into the vessels of the neck, is usually accompanied by a thrill. Moderate left ventricular enlargement and a normal blood pressure with relatively little left axis deviation tend to differentiate this lesion from acquired rheumatic heart disease.

Subaortic Stenosis

1. History of heart disease from birth or early infancy
2. No history of rheumatic fever
3. Loud systolic murmur and thrill over aortic area
4. Moderate left ventricular enlargement
5. Normal blood pressure
6. More or less left axis deviation

ANOMALIES OF THE AORTIC ARCH

Various anomalies of the aortic arch may occur. Usually these defects do not produce symptoms and are only of academic interest. Occasionally, however, they may produce the so-called vascular ring, resulting in a constrictive pressure of both the esophagus and trachea. This may produce difficulty in breathing and dysphagia. Symptoms may occur shortly after birth and, unless recognized, may result in death. Infants with this lesion frequently have repeated attacks of upper respiratory infection. In older individuals, age changes resulting in dilatation of the aorta and arteriosclerosis of the aortic arch and branches may also produce dysphagia and difficult breathing. A correct diagnosis rests first on awareness, on the part of the clinician, that such a lesion may exist, but is actually made by careful roentgen studies with barium in the esophagus and iodized oil in the trachea. Angiocardiography should be of considerable assistance in this type of case.

Anomalies of Aortic Arch

1. Not uncommon
2. Usually give no symptoms
3. May produce vascular ring
4. Diagnosis made by x-ray examination
5. Angiocardiography may help

COARCTATION OF THE AORTA

Coarctation of the aorta consists of a narrowing or complete atresia of the aorta distal to the subclavian artery and close to the point of insertion of the ductus arteriosus. Two types are commonly described, infantile and adult. The infantile consists of a diffuse narrowing of the aortic isthmus, invariably accompanied by a patent ductus arteriosus. It is the result of a serious developmental defect, and is not compatible with life for more than a few months. The adult type is of more clinical importance and consists of a localized narrowing or atresia of the aorta close to the insertion of the ductus arteriosus, resulting in extensive development of collateral circulation, making possible a fairly adequate

circulation to the lower half of the body. Generally in children no symptoms are present; there is never cyanosis or clubbing of the fingers, as there is no opportunity for a mixture of venous and arterial blood. If the constriction of the aorta is marked, as the patient grows older there will be left ventricular enlargement and evidence of cardiac strain, as well as symptoms due to the hypertension in the upper half of the body.

The diagnosis is not difficult if the anomaly is kept in mind. Every case of so-called juvenile hypertension should be studied for the possibility of coarctation of the aorta. The extent of the findings will depend upon the degree of stenosis. In the young child with a relatively mild constriction, the findings will consist merely of an increase in blood pressure in the upper extremities with decrease or absence of pressure in the legs.

In examining all patients, it is important to palpate the abdominal aorta as well as the femoral artery, to note whether or not pulsation is present in these vessels. It is also important to take blood pressure readings in both arms and legs to rule out the possibility of coarctation. Together with an increased blood pressure in the upper extremities and the absence or decrease of blood pressure in the lower extremities, a difference in skin temperature will be found. The upper half of the body will be much warmer than the lower. In the well developed case, careful inspection in the proper light will reveal enlarged vessels, particularly on the posterior chest wall on either side of the spine. Sometimes it is easier to find these vessels by palpation.

The heart may or may not be enlarged to the left. Frequently an indefinite, non-diagnostic short systolic murmur is heard at the apex and along the left border of the sternum, as well as over the aortic area. However, if one remembers to listen over the back (which should always be done in studying patients with heart disease), he will hear a peculiar superficial vascular type of murmur which is generated in the enlarged collateral vessels. We have been able to make a diagnosis of coarctation in young children in a number of instances simply by listening for this vascular type of murmur over the posterior chest wall.

In the well advanced case, x-ray examination will reveal typical erosion of the ribs produced by the markedly dilated intercostal vessels. However, marked narrowing or even complete atresia of the aorta may occur in adults with no evidence of erosion of the ribs. Careful roentgen studies will frequently reveal an enlarged left subclavian artery and absence of the aortic arch. The aortic arch may be displaced downward and can be visualized only by careful examination. The roentgenologist may be able to suggest the diagnosis of coarctation of the aorta on the basis of the above findings even though no erosion of the ribs is present.

In about 25 per cent of the cases of coarctation of the aorta, an accompanying aortic regurgitation may be present, usually on the basis of a congenital bicuspid aortic valve. If the aortic regurgitation is of high grade, there may be marked enlargement of the left ventricle with the accompanying characteristic peripheral vascular findings.

Coarctation of the Aorta

1. Hypertension
2. Decreased blood pressure in lower extremities
3. Moderate left ventricular enlargement
4. Enlarged collateral vessels
5. Murmur over collateral vessels
6. Erosion of ribs (not always present)
7. Absence of aortic knob
8. Left axis deviation
9. More common in males

PATENT INTERVENTRICULAR SEPTUM

The most common congenital cardiac lesion is patency of the interventricular septum. This is a developmental defect and results in an arteriovenous shunt, thereby producing strain on the right side of the heart. The pressure being greater in the left ventricle than in the right, the shunt is always from the arterial to the venous side. The extent of the symptoms will depend on the size of the opening.

Commonly the defect is small and produces no symptoms. Patients are usually referred to the clinic because of accidental finding of the murmur and not because of any symptoms.

On clinical examination, physical development is normal, the heart is ordinarily not enlarged, a thrill is usually palpable at the lower end of the sternum, and over this area a prolonged harsh murmur obscures both heart sounds. The murmur is high-pitched and well transmitted throughout the anterior and posterior chest. On x-ray examination, the heart will usually appear normal in size and contour. With a larger defect, the heart may be considerably enlarged, and there may also be an enlargement of the pulmonary artery, as well as of the vessels of the lungs. The blood pressure is normal. The electrocardiogram will usually be normal, with the exception that in those cases where the defect interferes with the normal conduction of the bundle of His, an accompanying congenital heart block may be present.

Ordinarily the diagnosis is not difficult. Where the heart is considerably enlarged due to a large defect, there might be difficulty in differentiating this lesion from an interauricular septal defect. The differential diagnosis is based on the fact that the point of maximum intensity of the thrill and murmur in the interventricular defect is at the lower end of the sternum rather than over the pulmonary area. As far as the roentgen findings are concerned, the enlargement of the heart as well as the abnormality of the contour may be quite similar in both lesions. Ordinarily, however, as will be pointed out later, the heart is much larger in the interauricular septal defect.

Occasionally it will be necessary to differentiate between an interventricular septal defect and a rheumatic mitral lesion. A history of a heart condition from birth or early infancy, absence of a history of rheumatic infection, and presence of a thrill at the lower end of the sternum will lend support to the diagnosis of an interventricular lesion. Careful fluoroscopic examination will occasionally reveal a calcified mitral valve, which will clinch the diagnosis of mitral disease.

The great majority of patients have no symptoms and suffer more from apprehension on the part of their doctors than from the lesion itself. Rarely does one see cardiac decompensation resulting from an interventricular septal defect. There is, however, the danger of subacute bacterial endocarditis, either at the site of the defect or at a point opposite it on the right ventricular wall.

Interventricular Septal Defect

1. Loud murmur over lower end of sternum
2. Normal-sized heart
3. Slight enlargement of pulmonary artery
4. Normal blood pressure
5. Normal electrocardiogram

PATENT INTERAURICULAR SEPTUM

The interauricular septal defect is of the same nature as the interventricular septal defect, resulting from a failure of fusion between the various portions of the interauricular septum. Here again the symptoms and findings will depend on the extent and size of the opening. In patients with small openings, there will be no symptoms, and the physical findings will be minimal. In those patients who have large defects, characteristic findings are those of hypoplasia of the aorta, stunting of growth, and general underdevelopment accompanied by dyspnea and evidence of right heart strain.

On physical examination, a systolic murmur is usually heard over the pulmonic area. This murmur is variable and is not diagnostic. As a matter of fact, a good-sized interauricular septal defect may exist, with no murmur at all. The murmur, when present, is usually heard best in the second left interspace, is harsh and prolonged, obscures the first sound, and is well heard throughout the anterior and posterior chest. A thrill is frequently present over the pulmonic area. The second pulmonic sound is accentuated. Auscultation of the back reveals a vascular type of murmur gener-

ated in the enlarged pulmonary vessels. Occasionally a diastolic murmur is present. This may indicate relative pulmonary insufficiency due to a greatly dilated pulmonary artery.

On x-ray examination, in the presence of a small defect, the heart may be normal in size, but the pulmonary artery will be enlarged. In those cases with large defects, the heart will be tremendously enlarged. It is characteristically globular in shape. There will also be found marked enlargement of the pulmonary artery, as well as of the vessels of the lungs. Frequently no shadow of the aorta can be seen. On fluoroscopy, pulsation of the enlarged pulmonary artery as well as the enlarged vessels of the lungs will be noted. The x-ray contour is quite characteristic and one can frequently suspect the diagnosis from the film itself. The electrocardiogram reveals more or less right axis deviation.

In a number of cases of interauricular septal defect, there is an accompanying stenosis of the mitral valve. When this occurs, the condition is known as Lutembacher's disease.

Even patients with large defects frequently get along unusually well. They are, as has been stated, customarily underdeveloped, and their physical underdevelopment is quite characteristic in many instances. In such patients cardiac decompensation with auricular fibrillation may occur, but rarely subacute bacterial endocarditis. Many of them do exceedingly well despite the marked enlargement of the heart.

Interauricular Septal Defect

1. Physical underdevelopment
2. Systolic murmur over pulmonic area
3. Enlargement of right heart
4. Enlargement of pulmonary artery and branches
5. Hypoplasia of left ventricle and aorta
6. Normal blood pressure
7. Right axis deviation

PATENT DUCTUS ARTERIOSUS

In utero, the ductus arteriosus is a vessel of considerable size. It acts as a by-pass, transmitting blood from the pulmonary artery into the aorta. In the normal newborn infant, this vessel closes within a few minutes after the first breath is taken. Recent research proves quite conclusively that the vessel does actually close, at least functionally, within the first few minutes of extra-uterine existence.

Symptoms and physical findings depend on the size of the duct. The pressure in the aorta being greater than in the pulmonary artery, the shunt will be from aorta to pulmonary artery, and there will therefore be no cyanosis. Patients with a small shunt will have no symptoms. In those with larger shunts, dyspnea, cough, easy fatigue, and other symptoms of cardiac failure will gradually develop. Some patients have complained particularly of the heavy beating of the heart and pounding of the vessels in the head and neck due to the wide pulse pressure. In the older literature, stunting of growth was noted as a common finding; in our experience this is rather uncommon.

The physical findings are quite characteristic, and there should be no difficulty in making the diagnosis. The typical patient presents the pathognomonic so-called "machinery" murmur, heard best in the second and third interspaces to the left of the sternum. Commonly this murmur is accompanied by a thrill in the same location. The murmur runs through the entire heart cycle, is systolic-diastolic in time, and is accentuated toward the end of systole. An accentuated second pulmonic sound is heard within the murmur. When the shunt is of considerable size, an accompanying enlargement of the pulmonary artery, as well as an enlargement of the pulmonary vessels, will be found. It is possible to have a very large patency of the ductus in the presence of no murmur at all. The diagnosis of patent ductus arteriosus has been made on the basis of a systolic murmur only. This is a dangerous procedure, however, and will frequently lead to errors. It must be extremely rare for patent ductus arteriosus to be present when only a systolic murmur is heard.

Together with the characteristic machinery murmur over the pulmonic area, a vascular type of murmur will be heard posteriorly, being generated in the enlarged vessels in the lungs. In the patient with a small ductus, the blood pressure is normal. When the duct is of considerable size, there is a considerable increase in pulse pressure; accompanying this increase are the characteristic findings of Corrigan pulse, capillary pulse, and "pistol-shot femorals," much as in aortic regurgitation. Exercising the patient will frequently accentuate the increased pulse pressure.

On x-ray examination, in patients with small ducts the heart will be normal in size. Almost invariably, however, some enlargement of the pulmonary artery will be found. This is best brought out by films in the oblique projection or, better, by fluoroscopy. In patients with large ducts, the left and right ventricles are enlarged, and in some cases the left auricle as well. The pulmonary artery and the vessels in the lungs are enlarged and may be seen to pulsate under the fluoroscope. The aorta will be prominent. The apex of the heart will be out to the left and downward, indicating left ventricular enlargement.

Ordinarily the diagnosis of patent ductus arteriosus is not difficult. When the heart is greatly enlarged, however, and the murmur is not characteristic, differentiation from an interauricular septal defect will be necessary. It is important to remember that the shunt in patent ductus arteriosus is extracardiac, so that in a large heart with considerable shunting of blood into the pulmonary artery, one must necessarily find a high pulse pressure and the characteristic accompanying peripheral vascular findings. In the auricular septal defect, the shunt is intracardiac, so that the blood pressure and peripheral vascular findings will be normal even with marked cardiac enlargement. Furthermore, on x-ray examination, the apex will be high and rounded in the auricular defect, while in patent ductus arteriosus the apex is low and further to the left, due to enlargement of the left ventricle. In the auricular septal defect, the aorta is hypoplastic, while in patent ductus arteriosus the aorta is prominent and pulsates forcibly. In auricular septal defects the electrocardiogram will show right axis deviation while it is within normal limits in patent ductus arteriosus.

Patent Ductus Arteriosus

1. Typical machinery murmur
2. Heart may or may not be enlarged
3. Enlargement of pulmonary artery and branches
4. Prominent aorta
5. Increased pulse pressure
6. Normal electrocardiogram
7. More common in females

DEXTROCARDIA WITH SITUS TRANSVERSUS

Two types of dextrocardia occur. One is accompanied by a complete transposition of the abdominal viscera. This is clinically unimportant, as the heart is essentially normal. In the second type, only the heart is involved. In such instances there are invariably accompanying serious congenital cardiac abnormalities, usually resulting in cyanosis.

TETRALOGY OF FALLOT

About 70 per cent of all patients with cyanosis due to congenital maldevelopment of the heart suffer from inadequate pulmonary circulation due to pulmonary stenosis. This stenosis may be either valvular or involve the infundibulum of the right ventricle. When the pulmonary stenosis is accompanied by a high interventricular septal defect with the aorta riding over this defect and receiving blood from both ventricles, and when right hypertrophy is also present, the syndrome is known as the tetralogy of Fallot. In some instances there is failure of development of either the interauricular or interventricular septum, in which event the pulmonary stenosis may be accompanied by a bilocular or trilocular heart. For practical purposes, this is essentially the same lesion as the typical tetralogy of Fallot. In all such cases, the important factor is whether or not pulmonary circulation is adequate.

DIFFERENTIAL DIAGNOSIS

	Murmur	Blood Pressure	X-Ray Findings	Electrocardiogram
Patent interventricular septum	Prolonged. Obscures heart sounds. Heard best at lower end of sternum	Normal	Usually normal	Usually normal
Patent interauricular septum	Systolic murmur over pulmonic area. Not diagnostic	Normal	Heart enlarged. Globular. Marked enlargement of pulmonary artery and vessels. Aorta hypoplastic. Evidence of right ventricular enlargement	Right axis deviation
Patent ductus arteriosus	Typical machinery murmur over pulmonic area	Increased pulse pressure. Typical peripheral vascular findings	Heart moderately enlarged. Evidence of left ventricular enlargement. Aorta prominent. Large pulmonary artery and vessels	Normal
Aortic regurgitation, either congenital or rheumatic	Systolic and diastolic. No machinery murmur	As in patent ductus arteriosus	Left ventricular enlargement. Dynamic aorta. No involvement of lesser circulation	Left axis deviation

Cyanosis is due to the admixture of venous and arterial blood and to the retardation of flow by the stenotic pulmonary artery. Cyanosis develops early and may become very severe. Clubbing of the fingers accompanies the cyanosis. Dyspnea, cough, weakness, inability to carry on any type of work, occasional pulmonary hemorrhage, convulsions, and periods of unconsciousness due to cerebral anoxemia, are not uncommon. Polycythemia and increased hemoglobin accompany the high degree of cyanosis.

On physical examination, the cyanosis and clubbing of the fingers will be noted at once. There is usually a thrill over the pulmonic area, and over this area also a harsh murmur will be heard, which usually obscures both heart sounds, the pulmonary second sound not being heard. Not infrequently, in a far advanced case of this type, the murmur may be inconsequential and sound relatively unimportant. The patients are usually undernourished and underdeveloped, and it is not uncommon, as the case progresses, for deformity of the spine, kyphosis, and marked scoliosis to develop. Percussion will not usually reveal enlargement of the heart. On x-ray examination, however, the cardiac contour is quite characteristic, and in many instances a diagnosis of tetralogy of Fallot may be suspected from the film alone. There is, however, marked variation in the roentgen findings, and the heart may even appear well within normal limits. While the heart is not absolutely enlarged, the apex is high over the diaphragm and rounded, indicating relative right ventricular hypertrophy. Absence of the pulmonary artery results in a scaphoid contour along the left border. In many instances the aorta is to the right of the sternum and the entire configuration produces the so-called *coeur en sabot*, or wooden shoe-shaped heart. The pulmonary vessels will be minimal in size, the lungs will appear unusually clear, and there will be no evidence of pulmonary congestion. Electrocardiograms will show a pronounced right axis deviation.

Tetralogy of Fallot

1. Increasing cyanosis from birth
2. Systolic murmur from birth
3. Normal-sized heart
4. Relative right ventricular enlargement (*coeur en sabot*)
5. Diminished shadow of pulmonary artery and branches
6. Marked right axis deviation

EISENMENGER'S COMPLEX

Eisenmenger's complex consists of an interventricular septal defect, dextroposition of the aorta, and a normal or dilated pulmonary artery. This is exactly the same lesion as the tetralogy of Fallot except that there is no pulmonary stenosis; it is far less common. Cyanosis is due almost entirely to the venous-arterial shunt. The cyanosis and clubbing are usually of moderate degree and develop in later life. They will be apparent on physical examination. A systolic murmur will be heard over the pulmonic area, but will not ordinarily obscure the second pulmonic sound. X-ray examination will show the heart to be globular in shape and commonly larger than in the tetralogy of Fallot; in addition, there will be a normal or dilated pulmonary artery and the vessels in the lungs will be normal or enlarged. The electrocardiogram will reveal more or less right axis deviation. Since surgery is not now feasible in the Eisenmenger complex, its differentiation from the tetralogy of Fallot is important.

Eisenmenger's Complex

1. Late, moderate cyanosis
2. Systolic murmur over pulmonic area
3. Moderate globular enlargement of heart
4. Enlarged pulmonary artery and branches
5. Right axis deviation

PULMONARY STENOSIS

Stenosis of the pulmonary artery may appear as the sole congenital lesion. The stenosis more commonly involves the valve itself but may affect the infundibulum of the right ventricle. In patients with this lesion cyanosis does not develop, as a rule, until early adulthood. Clubbing of the fingers is usually minimal. On auscultation, a harsh systolic murmur is heard over the pulmonic area, frequently obscuring both heart sounds. On x-ray examination the heart is seen to be moderately enlarged, rather globular in contour due to enlargement of the right ventricle and auricle. Not uncommonly there is considerable enlargement of the pulmonary artery as a result of so-called post-stenotic dilatation. The vessels in the lungs, however, are not enlarged and do not pulsate. The electrocardiogram reveals more or less right heart strain.

Pulmonary stenosis with an accompanying patent foramen ovale results in the production of early increasing cyanosis and clubbing of the fingers. The pressure in the right auricle is higher than in the left due to the stenotic pulmonary artery. This results in a right to left shunt, thereby producing cyanosis.

Pulmonary Stenosis

1. Moderate, late cyanosis
2. Systolic murmur over pulmonic area
3. Globular enlargement of heart
4. Decreased shadow of pulmonary vessels
5. Right axis deviation

TRICUSPID ATRESIA WITH UNDERDEVELOPED RIGHT VENTRICLE

Pulmonary stenosis or atresia is sometimes accompanied by tricuspid atresia and an underdeveloped or rudimentary right ventricle. Ordinarily this combination of lesions is not compatible with life, and death usually ensues a short time after birth. Rarely, however, such infants live beyond the age of two and then become a problem in differential diagnosis. In such instances the diagnosis is made almost entirely by careful radiologic studies. On fluoroscopy or with oblique films, left ventricular enlargement will be noted. The right ventricle will be small. This is the only lesion producing cyanosis in which left axis deviation is found in the electrocardiogram.

Pulmonary Stenosis with Tricuspid Atresia and Underdeveloped Right Ventricle

1. Increasing cyanosis from birth
2. Systolic murmur over pulmonic area
3. Normal-sized heart
4. Relative left ventricular enlargement
5. Left axis deviation

TRANSPOSITION OF GREATER VESSELS

In transposition of the greater vessels, the aorta rises from the right ventricle and

the pulmonary artery from the left ventricle. The two circulations are independent of each other and admixture of blood is possible only through the patent ductus arteriosus or a septal defect. The great majority of the patients die within the first few days or weeks of life. Occasionally one lives long enough so that the condition becomes a factor in differential diagnosis, in determining whether or not operation is indicated. At birth such infants may not reveal any apparent cyanosis, and the heart may be normal in size. In a few days or weeks, however, the heart enlarges progressively and the infant becomes more and more cyanotic. This lesion is frequently accompanied by tremendous cardiac enlargement. The heart is globular in contour and is narrow at the base. In the oblique view, the shadow at the base of the heart becomes wide. This lesion is frequently accompanied by various other congenital defects.

TRUNCUS ARTERIOSUS

The condition known as truncus arteriosus results from a failure of the division of the septum between the aorta and the pulmonary artery. The truncus arteriosus serves the function of both the aorta and pulmonary artery and is usually a vessel of large caliber, receiving blood from both ventricles. When the pulmonary arteries arise from this main common trunk, there may be no cyanosis, and the patient may get along fairly well into early adulthood. If the pulmonary artery is rudimentary and the lungs get their circulation through the bronchial arteries then there will be cyanosis. There are no diagnostic findings on auscultation. Usually a systolic murmur is heard and a thrill may be present. The contour of the heart as seen on the x-ray film may be quite typical. Angiocardiography should help in diagnosing this lesion.

DISCUSSION

This superficial and incomplete résumé of the clinical findings in the major congenital heart lesions has been presented with the hope that such information may help the roentgenologist in his interpretation of the x-ray findings. A well informed roentgenologist can frequently assist the clinician in making a precise diagnosis, thereby obviating the necessity for such formidable diagnostic procedures as angiocardiography and catheterization of the heart.

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SUMARIO

Diagnóstico de las Cardiopatías Congénitas con las Técnicas Corrientes

Este resumen superficial e incompleto de los hallazgos clínicos en las más importantes lesiones congénitas del corazón es ofrecido con la esperanza de que sus datos ayuden al radiólogo a interpretar los hallazgos roentgenológicos, capacitándolo así para auxiliar al clínico en formular el diagnóstico, y quizás evitando la necesidad de abordar procedimientos tan formidables como son la angiocardiografía y el cateterismo cardíaco.

Estenosis subaórtica:
- Historia de cardiopatía desde el nacimiento o primera infancia
- Falta de antecedentes de reumatismo
- Fuerte soplo y estremecimiento sistólico sobre la zona de la aorta
- Moderada hipertrofia del ventrículo izquierdo
- Tensión sanguínea normal
- Más o menos desviación del eje hacia la izquierda

Anomalías del cayado de la aorta:
- No son raras
- No suelen acusar síntomas
- Pueden producir anillo vascular
- Diagnóstico con los rayos X
- La angiocardiografía puede ayudar

Coartación de la aorta:
- Hipertensión
- Hipotensión en los miembros inferiores
- Moderada hipertrofia del ventrículo izquierdo
- Hipertrofia de los vasos colaterales
- Soplo sobre los vasos colaterales
- Erosión de las costillas (no siempre)

Ausencia de prominencia aórtica
Desviación del eje hacia la izquierda
Más frecuente en los varones

Deformación del tabique interventricular:
Soplo fuerte sobre el extremo izquierdo del esternón
Corazón de tamaño normal
Ligera hipertrofia de la arteria pulmonar
Tensión sanguínea normal
Electrocardiograma normal

Deformación del tabique interauricular:
Imperfecto desarrollo físico
Soplo sistólico sobre la zona pulmonar
Hipertrofia del corazón derecho
Hipertrofia de la arteria pulmonar y ramas de la misma
Hipertrofia del ventrículo izquierdo y de la aorta
Tensión sanguínea normal
Desviación del eje hacia la derecha

Conducto arterioso permeable:
Típico soplo de maquinaria
Puede haber o no hipertrofia cardíaca
Hipertrofia de la arteria pulmonar y ramas de la misma
Prominencia aórtica
Hipertensión del pulso
Electrocardiograma normal
Más frecuente en las mujeres

Tetralogía de Fallot:
Cianosis creciente desde el nacimiento
Soplo sistólico desde el nacimiento
Corazón de tamaño normal
Relativa hipertrofia del ventrículo derecho (*coeur en sabot*)
Sombra atenuada de la arteria pulmonar y sus ramas
Pronunciada desviación del eje hacia la derecha

Complejo de Eisenmenger:
Cianosis moderada, tardía
Soplo sistólico sobre la zona pulmonar
Moderada hipertrofia globular del corazón
Hipertrofia de la arteria pulmonar y sus ramas
Desviación del eje a la derecha

Estenosis pulmonar:
Moderada cianosis, tardía
Soplo sistólico sobre la zona pulmonar
Hipertrofia globular del corazón
Sombra atenuada de los vasos pulmonares
Desviación del eje a la derecha

Estenosis pulmonar con atresia tricúspide e imperfecto desarrollo del ventrículo derecho:
Cianosis creciente desde el nacimiento
Soplo sistólico sobre la zona pulmonar
Corazón de tamaño normal
Relativa hipertrofia del ventrículo izquierdo
Desviación del eje a la izquierda

Conventional Roentgenography in the Diagnosis of Cardiovascular Anomalies[1]

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THE ACHIEVEMENTS of cardiovascular surgery during the last decade have stirred renewed interest in the diagnosis of congenital cardiovascular malformations, and extensive case-finding programs have been developed to aid in the recognition of those lesions amenable to surgical correction. Accurate clinical diagnosis is often difficult, and recourse to some of the new diagnostic technics by a team consisting of clinician, radiologist, and cardiovascular physiologist requires a concentration of talent and procedures that are time-consuming and expensive. From a practical standpoint, it is necessary to screen the large numbers of patients who present themselves for a consideration of surgical therapy and to separate those that can be easily recognized as amenable to surgical treatment from those requiring the additional studies upon which an evaluation of operability may be based. The roentgenologist's recognition of the diagnostic capacities and limitations of conventional roentgenographic examinations will significantly affect the success of the entire program.

The roentgenological survey should be expected to contribute objective information on cardiac size, the characteristics of the individual cardiac chambers, the size and position of the great vessels, and the size of the intrapulmonary vessels. Intelligent interpretation of the roentgenographic findings requires careful correlation with the findings on physical examination and with the clinical laboratory data. A complete roentgenologic survey should include roentgenoscopy and roentgenography in the standard right-angle and oblique projections, together with the judicious use of esophograms, tracheograms, kymograms, and planigrams when indicated for their supplemental contributions. Roentgenologic interpretation is facilitated by a simple classification of the common cardiac malformations grouped according to the presence or absence of cyanosis, with subgroupings based upon the character of the pulmonary artery segment of the left heart border. The following classification has proved useful in differential diagnosis.

I. Cardiac malformations in which cyanosis is present
   - (*a*) Pulmonary artery segment absent
     1. Tetralogy of Fallot
     2. Transposition of great vessels
     3. Truncus arteriosus
     4. Non-functioning right ventricle (tricuspid atresia)
   - (*b*) Normal or full pulmonary artery segment
     1. Isolated pulmonary stenosis
     2. Eisenmenger complex
     3. Single ventricle with pulmonary artery from rudimentary chamber

II. Cardiac malformations in which cyanosis is absent
   - (*a*) Absent pulmonary artery segment
     1. Truncus arteriosus with pulmonary arteries from a common trunk
   - (*b*) Normal pulmonary artery segment
     1. Coarctation of the aorta
     2. Ventricular septal defect
     3. Aortic and subaortic stenosis
     4. Atrioventricularis communis
   - (*c*) Full pulmonary artery segment
     1. Auricular septal defect (including Lutembacher's syndrome)
     2. Patent ductus arteriosus
     3. Eisenmenger complex
     4. Ventricular septal defect.

No attempt has been made to include all malformations that may require consideration in differential diagnosis, and the many malformations of the aortic arch and anom-

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alies of the great veins have been excluded. The occurrence of these vascular anomalies as isolated lesions or in combination with other cardiac malformations seems justification for considering them as special cases in the interest of a simplified grouping. Some lesions must be considered in both cyanotic and acyanotic groups, since variation in the direction of shunts will modify the amount of unsaturated arterial hemoglobin.

CONTRIBUTIONS OF THE SURVEY EXAMINATION

The roentgenographic evidence of the amount of cardiac enlargement has clinical significance, both in the evaluation of the type of malformation and in estimation of the risk of operation. Taussig states that the cardiothoracic ratio offers a useful guide to the estimation of cardiac reserve, a ratio of 60 per cent indicating adequate adjustment for maintenance of compensation. Marked enlargement usually indicates an inability of the heart to adjust to the abnormal circulation.

An analysis of the relative size of the right and left ventricles is so important in differential diagnosis that correlation with electrocardiographic evidence of axis deviation should become a routine procedure. The shape of the heart is determined by the relative size of its component chambers and vessels and is therefore better described by chamber analysis than by such descriptive terms as globular and boot-shaped.

Evaluation of the size of the intrapulmonary arteries as evidence of changes in the pulmonary circulation deserves a more adequate description than is conveyed by the terms "congestion" or "clear lung fields." The size of the pulmonary arteries *per se* cannot, however, be expected to differentiate the engorgement due to peripheral obstruction, left to right shunts, and extensive collateral circulation through the bronchial arteries.

Wood and Miller have demonstrated enlargement of the bronchial arteries with numerous large anastomoses with the pulmonary arteries in chronic inflammatory pulmonary diseases, chronic passive congestion, Ayerza's disease, emphysema, and asthma. Extensive anastomoses between the bronchial and pulmonary arteries have been demonstrated after experimental ligation of the pulmonary artery and in patients with the congenital malformation of pulmonary stenosis or atresia. The anastomoses in human subjects with pulmonic stenosis tend to occur somewhat closer to the hilus than is the case in chronic inflammatory pulmonary disease. Bing, Vandam, and Gray have called attention to the significance of this collateral circulation from bronchial arteries and have warned against the danger of misinterpretation of expansile pulsations of hilar vessels, characteristically seen in the Eisenmenger syndrome but which can also be observed in pulmonic stenosis when there is a large collateral circulation.

LESIONS TO BE DIFFERENTIATED FROM CARDIAC MALFORMATIONS

Roentgen diagnosis in the early neonatal period presents many problems related to the respiratory and circulatory adjustments after birth. Heart murmurs and cyanosis associated with persistent lobular atelectasis of the lungs and an elevated diaphragm may be easily confused with congenital heart disease. Follow-up examinations are indicated to observe the effects of an altered circulation on cardiac size and contour.

Cardiac Hypertrophy and Macrosomia: We have been in error on numerous occasions in suspecting cardiac malformations in infants born to diabetic mothers. Miller has shown that in such infants the findings of cardiac hypertrophy, excessive erythropoiesis in the liver, hyperplasia of the islands of Langerhans, and macrosomia are more frequently encountered when the birth weight is over 3,900 gm. than when it is less than that amount. In some of these cases the associated clinical findings included cyanosis, dyspnea, and murmurs. A progressive decrease in cardiac size observed during the first six weeks of life, together with the mother's antecedent

history, should aid in differential diagnosis of this type of cardiac hypertrophy.

CASE 1: A male infant born of a diabetic mother weighed 3,425 gm. He did not breathe for two or three minutes after birth and was given 95 per cent oxygen and 5 per cent carbon dioxide. At twelve hours of age the cry was weak and the skin an ashen gray color. The heart sounds were louder than usual and a gallop rhythm was present. A loud systolic murmur was heard. The blood sugar was 160 mg. per cent. On the second day there was some cyanosis of the hands and face. On that day there were 2,250 erythroblasts per cubic millimeter, and none thereafter. The systolic murmur continued to be present until the end of the first month of life but has not been heard since on many examinations. The heart and kidneys were notably enlarged on the first and second days. Some decrease in the size of the heart was noted on the fourth, eighth, and fifteenth days. The last examination, at eighteen months of age, was entirely normal.

Idiopathic Cardiac Hypertrophy: We have seen six children who presented a clinical picture characterized by an acute onset of dyspnea, pallor, cough, and cyanosis, terminating in a rapid exitus. All of these patients showed generalized cardiac enlargement. The autopsy findings characteristically show endocardial fibrosis, cardiac hypertrophy, and dilatation. Powers and LeCompte have reported the findings in one of these patients and suggest the probability of some cardiac muscle hyperplasia to account for the increase in size of the heart, in view of an absence of any evidence of hypertrophy of muscle fibers.

CASE 2: A six-month-old female infant had been perfectly well until the age of five months, when she began to refuse feedings. She lost weight and showed increasing pallor and two days before admission vomited all feedings. On admission she was extremely weak, and was vomiting.

Physical examination revealed signs of circulatory collapse in a moribund, cyanotic child. The temperature was 104°, pulse 176, respirations 76. The child was well nourished. The heart was enlarged to percussion but there were no murmurs. Heart sounds were of poor quality. The liver was palpable three finger-breadths below the costal margin. Auscultation of the lungs revealed prolongation of expiration with occasional squeaks and groans. Death occurred on the day following admission and postmortem findings revealed a heart weighing 110 gm. (normal for age 22 gm.). All chambers were dilated and hypertrophied. There was endocardial fibrosis, particularly marked in the wall of the left

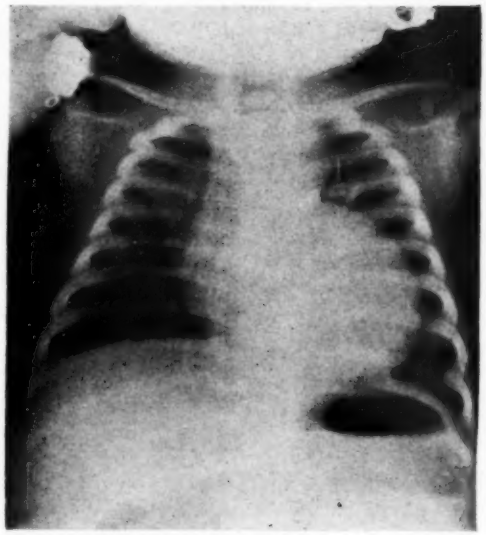

Fig. 1. Case 3: Postero-anterior view of chest. Cardiac enlargement in an infant with glycogen storage disturbance, Von Gierke's disease.

auricle and ventricle, with dense fibroblastic connective tissue at the top of the interventricular septum. This was also seen around the Purkinje fibers of the left bundle. There was no hemorrhage, nor were there any signs of acute inflammation. There was no evidence of excess glycogen in the heart muscle. The anatomical diagnosis was congenital idiopathic hypertrophy of the heart.

Von Gierke's Disease: In differential diagnosis of cardiac enlargement of unknown etiology consideration must be given to glycogen storage disease. In comparison with the previous case history the following offers some points of similarity.

CASE 3: A six-month-old female child with a history of a normal delivery and a normal neonatal period up to the age of three months was seen in the Outpatient Department because of flabby extremities and loss of use of her legs. At this time a macroglossia was noted. Examination of the chest was not notable, though roentgenograms showed cardiac enlargement. Because of the weakness of the extremities, a tentative diagnosis of amytonia congenita was made. On admission, at six months of age, the patient was irritable, with an elevation of temperature to 104° and rapid respirations. She was hypotonic, pale, without cyanosis but with evidence of enlargement of the heart. A loud, rough systolic murmur was best heard in the axilla. The liver was enlarged. The spleen was not felt. Clinical signs of pneumonia were found in the

right lung. The blood count was essentially normal except for elevation of the white cell count to 21,000. Lumbar puncture was negative. An electrocardiogram revealed a marked depression of the ST segments and inverted T waves in all leads. The child died suddenly on the second hospital day.

At autopsy the heart was found to weigh 110 gm. There was marked "hypertrophy," especially of the left ventricle, without valvular or septal defects. The left ventricle measured 22 mm. in thickness, the right 15 mm. The muscle fibers showed vacuoles containing glycogen. The liver weighed 290 gm. and contained glycogen, but not in increased amounts. Analysis of heart muscle showed 5 per cent and skeletal muscle 2 per cent glycogen content.

Although the roentgenographic findings in the cases of cardiac hypertrophy occurring in infancy are characterized by generalized enlargement, the cardiac contours in the three illustrative cases of hypertrophy and macrosomia, idiopathic hypertrophy, and glycogen storage disease, are sufficiently varied to create difficulty in differential diagnosis of congenital malformations. The case history is believed to make the most significant contribution to a correct analysis and interpretation.

CARDIAC MALFORMATIONS

Of the three general types of congenital cardiovascular malformations amenable to surgical correction at the present time, we are chiefly concerned here with problems in differential diagnosis of the abnormality in which there is pulmonic stenosis or atresia, an interventricular septal defect, an aorta which overrides the defect and receives blood from both ventricles with resultant right ventricular enlargement, *i.e.*, the tetralogy of Fallot. Patients with pulmonic stenosis in whom some mixed venous blood enters the aorta have been benefited by the creation of an artificial ductus arteriosus. This group includes, in addition to the tetralogy, non-functioning right ventricle with functional pulmonic stenosis, single ventricle with pulmonic stenosis, truncus arteriosus with bronchial arteries and a rudimentary pulmonary artery which does not communicate with the heart or aorta, transposition of the great vessels associated with interventricular defect, and pulmonic stenosis. All of these lesions have in common an inadequate pulmonary flow of blood.

New surgical technics now in an experimental stage of development promise a future increase in the number of types of malformations that may become amenable to correction. It is therefore necessary to develop our ability to recognize and differentiate as many of these malformations as possible.

MALFORMATIONS IN WHICH CYANOSIS IS PRESENT AND THE PULMONARY ARTERY SEGMENT IS ABSENT

Transposition of the Great Vessels: With complete transposition of the aorta and pulmonary artery there must be an associated patent ductus or some type of septal defect if the condition is to be compatible with life. The size and position of the septal defects and the direction of shunting are variable. Cyanosis is therefore variable; it is less intense in the lower trunk and extremities when a shunt *via* the ductus supplies oxygenated blood to the descending aorta. The heart is enlarged, the waist narrow with absence of the convexity of a normal pulmonary artery segment. The intrapulmonary vessels are normal in size or show engorgement from intracardiac left-to-right shunts which increase the volume flow through the lungs. The shadow of the great vessels may be widened in a left anterior oblique projection, or with slight rotation some separation of aorta and pulmonary artery may indicate their abnormal relationship. Enlargements of both right and left ventricles result in such marked cardiac enlargement as to obscure the hili and require overexposed films for estimation of the size of the hilar vessels. In spite of the marked left ventricular enlargement which develops to maintain circulation to the lower trunk and extremities through a patent ductus, the electrocardiogram usually indicates a right axis deviation.

CASE 4: An infant of six and a half weeks was admitted with a diagnosis of congenital heart disease. During the first two and one half days after birth the

child had two transient episodes of cyanosis. X-ray examination at that time revealed an enlarged heart, and a heart murmur is said to have been heard. The child always breathed heavily. She had been a "feeding problem," with cyanosis around the mouth after feeding.

On admission, the patient was extremely small and poorly nourished, with rapid respirations and persistent expiratory grunt. There was a dusky blue tint to the skin. The heart was enlarged, with a rapid rate, regular rhythm, sounds of poor quality, and a loud, harsh, blowing bruit audible at the second and third interspaces to the left of the sternum, thought to be systolic in time. The liver was slightly enlarged.

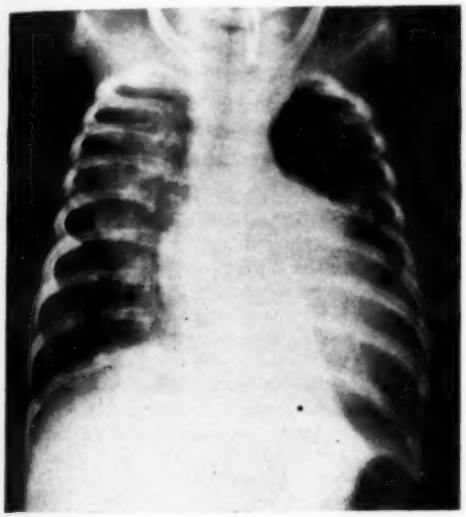

Fig. 2. Case 4: Postero-anterior view of chest of four-month-old infant with transposition of aorta and pulmonary artery communicating through a widely patent ductus arteriosus.

The electrocardiogram showed normal axis and T waves inverted in Lead I. Repeated electrocardiograms revealed axis shift to the right.

Roentgenographic examination showed an enlarged heart with evidence of engorgement of the intrapulmonary vessels. The patient was maintained on digitalis and kept in oxygen, but even in oyxgen had frequent attacks of dyspnea and cyanosis. She died at four months of age.

The postmortem examination revealed a dilated, enlarged heart, with complete transposition of the aorta and pulmonary artery, and a widely patent ductus arteriosus. The foramen ovale was widely patent, constituting an interauricular septal communication. A second, very small, interventricular septal defect was located by probing.

Truncus Arteriosus: A second important malformation to be differentiated from the tetralogy of Fallot is truncus arteriosus. This malformation may occur in two forms. A common trunk receiving blood from both ventricles may give origin to both aorta and pulmonary arteries, or a single great vessel receiving blood from both ventricles may direct blood to the systemic circulation, with the bronchial arteries supplying the lungs. In the presence of the latter malformation, if a rudimentary pulmonary artery of adequate size exists without proximal communication with the heart or aorta, the patient may benefit from a Blalock-Taussig procedure. Our experience has been limited to three cases that require classification as truncus arteriosus and agenesis of the pulmonary artery. The roentgen findings simulate those of the tetralogy of Fallot except that the left anterior oblique projection shows a "shelf-like" contour of the superior cardiac border from which the aortic trunk arises. The intrapulmonary hilar arteries are not identified in their normal position, and a network of fine vessels interlace in both hilar regions.

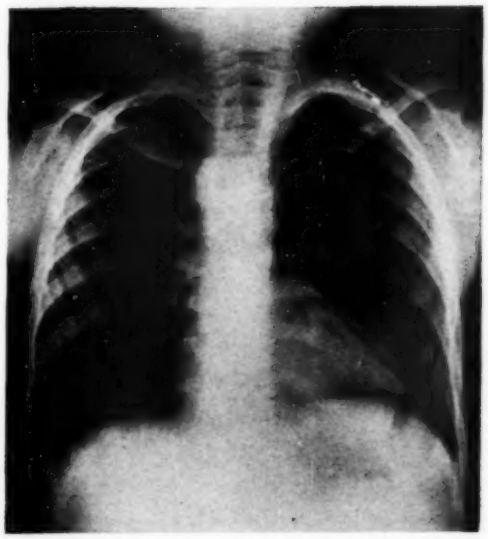

Fig. 3. Case 5: Postero-anterior view of the heart of four-year-old child with truncus arteriosus. Pulmonary circulation was through four bronchial arteries arising from the descending aorta.

CASE 5: A four-and-one-half-year-old girl had been normal until eight weeks of age, when cyanosis

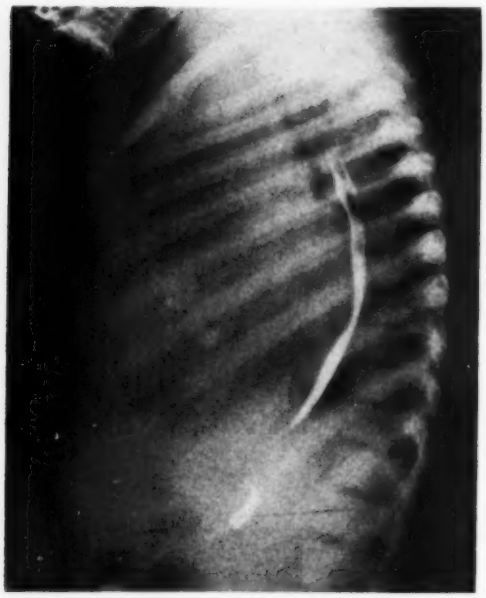

Fig. 4. Case 6: Lateral view of the chest of Negro child two and one-half years old, showing calcified thrombi in the cavity of a non-functioning right ventricle.

of the lips and extremities developed. She was seen at another hospital, where a diagnosis of tetralogy of Fallot was made at the age of seven months. She continued to present cyanosis of the extremities, which became generalized during periods of excitement or respiratory infection. At two and one half years of age, clubbing was noted and there was cyanosis of the entire body. The heart was moderately enlarged, without murmurs or thrills. An electrocardiogram at this time showed a right axis shift. The red blood cell count varied from 9,000,000 to 12,000,000; hemoglobin was 18 gm. The child developed poorly, and on the third hospital admission, cyanosis and clubbing were present without cardiac murmurs. Arterial blood showed an oxygen saturation of 47 per cent, with a hemoglobin of 20.7 gm. and a packed cell volume of 73 per cent. The clinical diagnosis was tetralogy of Fallot with right aortic arch. Exploratory thoracotomy was undertaken. A pulmonary artery could not be found, and the patient died suddenly on the table.

Postmortem examination revealed a truncus arteriosus and a right aortic arch, interventricular septal defect, marked enlargement of bronchial arteries, hypertrophy and dilatation of the right ventricle and auricle, but no pulmonary artery. The right ventricle opened into a dextroposed aorta straddling an interventricular septal defect measuring 1.0 cm. in diameter. The aortic arch crossed to the right of the trachea and descended on the right side posteriorly. The descending aorta gave off a common trunk with four equal-sized branches, two to the right and two to the left hili of the lungs. No other pulmonary arteries were found; the veins were normal. One of the left bronchial arteries had been partially dissected in the search for a pulmonary artery.

Non-Functioning Right Ventricle: Cyanosis resulting from a non-functioning right ventricle associated with tricuspid atresia or hypoplasia and pulmonary stenosis or atresia should constitute a malformation suitable for surgical correction by a Blalock-Taussig procedure. The following case history illustrates this type of malformation but the patient had no cyanosis until the development of cardiac failure. A patent ductus communicated with a normal-sized pulmonary artery.

CASE 6: A two-and-one-half-year-old colored girl had first been seen at one year of age, at which time mental retardation and evidence of congenital heart disease were noted. She was admitted to the hospital with edema of the face and other evidence of cardiac failure. A faint systolic murmur was heard over the entire precordium. Roentgenologic examination revealed an enlarged heart with the left border extending to the lateral chest wall and widening of the supracardiac mediastinal density. Within the cardiac silhouette were two rounded calcified shadows which were seen to follow the cardiac pulsations on roentgenoscopy. On pericardial tap 25 c.c. of bloody fluid were obtained and replaced by air. The calcifications were localized to the region of the right ventricle. One month later clubbing was noted for the first time. A diastolic murmur was heard in addition to the systolic murmur previously described. Clinical cyanosis was first noted one month after this and was associated with definite clubbing of the fingers.

The electrocardiogram showed left axis deviation which was considered probably normal. There were progressive increases in the polycythemia and evidence of rapid reaccumulation of fluid in the pericardial cavity. The patient died suddenly following the onset of an upper respiratory infection.

Postmortem examination showed great enlargement of the auricles, more marked on the left, and a greatly enlarged foramen ovale. The tricuspid valve leaflets were diminutive. The opening measured 7 mm. The right ventricle was very small, measuring less than 1.0 cm. in diameter. The cavity was almost completely filled by two masses of calcified material. The remainder of the cavity contained thrombi adherent to the walls. There was atresia of the pulmonary conus and artery. The ring of the pulmonary valve measured less than

2 mm. The artery terminated in a dilated bulb 1.5 cm. above the valve. A large patent ductus communicated with a normal-sized pulmonary artery which had no continuity with the artery arising from the right ventricle.

Delay in the clinical recognition of cyanosis, particulary in Negroes, emphasizes the importance of the determination of arterial oxygen saturation. The failure to correlate the calcified thrombi with the important diagnostic sign of left axis deviation should be emphasized.

MALFORMATIONS IN WHICH CYANOSIS IS PRESENT AND THE PULMONARY ARTERY SEGMENT IS DILATED

Cyanosis associated with a large pulmonary artery segment but inadequate pulmonary circulation suggests the malformation of isolated pulmonary stenosis without septal defect or dextroposition of the aorta. This lesion is to be differentiated from an Eisenmenger complex in which the intrapulmonary arteries are likely to be increased above normal size. A single ventricle with the pulmonary artery arising from a rudimentary outlet chamber may also require differentiation, since the latter may benefit from an artificial ductus if extreme pulmonary stenosis or atresia is present, while isolated pulmonary stenosis is unlikely to profit by the operation.

The following case is of interest because the clinical picture simulated chronic nephritis.

CASE 7: A two-and-one-half-year-old male was referred for consideration for surgical treatment of congenital heart disease. The child had never been vigorous and tired easily. At two years of age he was noted to have enlargement of the abdomen with progressive development of edema of the face, legs, and arms. He had transient episodes of cyanosis of the lips. A heart murmur was also first heard at two years of age, following which there was cardiac failure, with good response to digitalis therapy.

On physical examination, a grade 3 systolic murmur was noted. It was transmitted over the entire precordium. The size of the heart could not be determined. There was generalized pitting edema with evidence of ascites and enlargement of the liver. There was no cyanosis or clubbing. Blood pressure was 104/70. The electrocardiogram showed a sinus tachycardia with a right axis shift and slurring of the QRS complex in Leads I, II, and III. There was evidence of a slight degree of unsaturation of arterial blood (90 per cent) which was relieved by breathing pure oxygen.

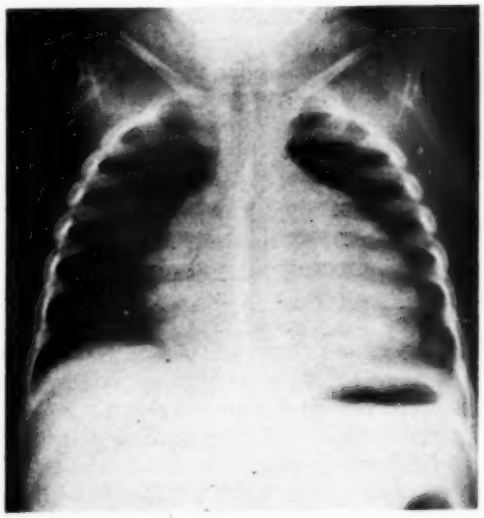

Fig. 5. Case 7: Postero-anterior view of chest of child two and one-half years old with pulmonic stenosis and post-stenotic dilatation of the artery. The left heart border is formed by the enlarged right ventricle.

The child died suddenly in the second week of hospitalization, and postmortem examination showed only 32 c.c. of pericardial fluid. There was marked enlargement of the right auricle and ventricle. The pulmonary valve was stenotic due to fusion of the cusps with an orifice measuring 3 mm. in diameter. The pulmonary artery distal to the valve was dilated. The tricuspid valve measured 8 mm., the mitral 5.5 mm. The ductus was not patent. The foramen ovale was closed. There was no overriding of the aorta and no anomalous communication between auricles or ventricles.

The cardiac size and contour in this case strongly suggested a pericardial effusion. The decreased size of the intrapulmonary arteries, the enlarged liver and ascites, and the moderate degree of oxygen unsaturation in the arterial blood relieved by breathing pure oxygen, should have led to a correct diagnosis of pulmonic stenosis.

MALFORMATIONS IN WHICH CYANOSIS IS ABSENT

The majority of malformations in which cyanosis is absent except as a transient or terminal manifestation of cardiac failure present a normal or dilated pulmonary

artery segment. An exception is to be found in the case of a common truncus arteriosus with pulmonary arteries arising from the trunk. In this anomaly the pulmonary artery segment is said to be absent or concave. The association of normal or engorged intrapulmonary vessels is a further roentgen sign of adequate pulmonary flow to the lungs. Evidence of an increased flow through the pulmonary arteries requires differential diagnosis of the various septal defects which occur as auricular or ventricular or in combination, with or without dextroposition and patent ductus arteriosus.

The clinical and roentgenologic findings and differential diagnosis of auricular septal defects and patent ductus arteriosus have been well studied and described, with emphasis on the contrasts presented by these two lesions. Predominant right ventricular enlargement occurs in auricular septal defect and moderate degrees of left-sided enlargement are present in cases of patent ductus arteriosus.

Combined defects of both auricular and ventricular septa may be more difficult to recognize and can be confused with some of the lesions discussed under malformations in which cyanosis is present. The following case report illustrates the malformation of atrioventricularis communis. In this anomaly, a defect involving both septa, with fusion of the mitral and tricuspid orifices into one opening through the common septal defect, gives rise to what is essentially a trilocular heart with two auricles.

CASE 8: A male infant nine weeks of age was admitted with a clinical diagnosis of congenital heart disease. Rapid respirations and poor color had been noted by the mother since birth. The child fed slowly and with difficulty. Attacks of cyanosis were described, with crying and with a respiratory infection. At seven weeks of age wheezing respirations were noticeable. Two days before admission a heart murmur was heard and enlargement of the liver was noted. Cyanosis was moderate, the heart sounds were of poor quality, and a systolic murmur was heard over the entire precordium. Arterial oxygen saturation was 70.4 per cent. An electrocardiogram showed a right axis shift. The roentgenogram showed an enlarged, displaced heart with full pulmonary artery segment and engorged intrapulmonary vessels. Fever and signs of increasing pneumonia developed. The child died at four months of age.

Postmortem examination confirmed the impression of a trilocular heart, with hypertrophy, dilatation and rotation of the heart. There was an auricular septal defect and complete absence of the ventricular system. The pulmonary artery was dilated; there was emphysema of the right lung and atelectasis of the left lung, with congestion of lungs, liver, and kidneys.

The right auricle opened into a greatly enlarged common ventricle through a valve which was continuous with that of the left auricle. The right portion of this common valve had two leaflets and the left, three leaflets. The openings of the aorta and pulmonary artery were separated by a short, thick crista pulmonaris. The pulmonary artery was twice the size of the aorta.

SUMMARY

1. A simple classification of common cardiac malformations for use in differential roentgenologic diagnosis is suggested.

2. The contributions and limitation of conventional roentgenography are discussed.

3. Cases illustrative of verified common malformations are presented.

New Haven, Conn.

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SUMARIO

La Roentgenografía Convencional en el Diagnóstico de las Anomalías Cardiovasculares

En el diagnóstico de las anomalías cardiovasculares cabe esperar que la exploración radiológica aporte datos objetivos acerca del tamaño del corazón, las características de las distintas cámaras cardíacas, el tamaño y la posición de los grandes vasos y el tamaño de los vasos intrapulmonares. La siguiente clasificación de las malformaciones cardíacas más comunes es ofrecida como ayuda al diagnóstico diferencial.

I. Malformaciones cardíacas en las que hay cianosis presente:
   (*a*) Ausencia de un segmento de la arteria pulmonar:
      1. Tetralogía de Fallot
      2. Transposición de grandes vasos
      3. Tronco arterioso
      4. Falta de funcionamiento del ventrículo derecho (atresia tricúspide)
   (*b*) Segmento de la arteria pulmonar normal o completo:
      1. Estenosis pulmonar aislada
      2. Complejo de Eisenmenger
      3. Un solo ventrículo con la arteria pulmonar partiendo de una cámara rudimentaria

II. Malformaciones cardíacas sin cianosis:
   (*a*) Ausencia de un segmento de la arteria pulmonar:
      Tronco arterioso con las arterias pulmonares partiendo del mismo tronco
   (*b*) Segmento de la arteria pulmonar normal:
      1. Coartación de la aorta
      2. Deformidad del tabique ventricular
      3. Estenosis aórtica y subaórtica
      4. Atrioventricularis communis
   (*c*) Segmento completo de la arteria pulmonar:
      1. Deformación del tabique auricular (incluso síndrome de Lutembacher)
      2. Conducto arterioso permeable
      3. Complejo de Eisenmenger
      4. Deformación del tabique ventricular

Preséntanse casos típicos de algunas de esas malformaciones así como de ciertas lesiones del período neonatal, que hay que diferenciar de la malformación congénita, a saber: hipertrofia cardíaca y macrosomia en las criaturas de madres diabéticas; hipertrofia cardíaca idiopática; glucogenosis (enfermedad de von Gierke).

The Conventional Roentgen Examination in Operable Congenital Heart Disease[1]

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THE RECENT remarkable developments in the field of vascular surgery offering cure or palliation to those afflicted with certain forms of congenital heart disease (13, 3, 6, 12, 16) have made diagnosis in this field a much more pressing practical problem for the roentgenologist than it has ever been in the past. Heart catheterization (18, 8) and angiocardiography (19) are increasingly stressed because of the accurate anatomical and physiological data they often provide in a field where the label "congenital heart" was formerly the common final clinical diagnosis. To be successful, these methods require special equipment and specially skilled personnel. They entail a certain amount of discomfort and inconvenience to the patient and add at least some element of hazard to the diagnostic work-up of a case. Since the roentgenologic pictures in the various forms of congenital heart disease very often do not fit the classic textbook descriptions, there is a tendency to believe that the more elaborate methods of examination are required routinely. It has seemed worthwhile to review briefly the roentgen findings in the congenital heart lesions which at present are amenable to surgical measures, since it is our belief that from a practical point of view the selection of cases for surgery can be made, in the great majority of cases, from a careful correlation of the findings by the ordinary roentgenologic and clinical methods.

It has happened that to date no use has been made of angiocardiography or heart catheterization in the selection of cases for operation at the University of Minnesota Hospitals. Cases in which there was any serious doubt as to the diagnosis were not subjected to surgery, but the number of cases thus rejected is relatively small. It remains to be proved that the advantages of surgery will be made available to any considerable additional number of cases through the application of angiocardiography and heart catheterization. It may be that detailed angiocardiographic knowledge of the vascular arrangement in the individual case will eventually be demanded by the surgeon, but to date the great majority of cases that have been successfully operated upon in the various centers have been prepared for surgery without the more complex procedures.

It is not intended to minimize in any sense the role of angiocardiography and catheterization, but rather to indicate that their prime clinical value is in the occasionally encountered obscure case. We desire to emphasize certain broad general features of the roentgen picture which, when correlated with the clinical findings, permit a practical diagnostic classification and prognosis as to the possibility of benefit from surgical intervention. Certain variations from the classical pictures occur frequently enough to be important and will be stressed. Angiocardiography and catheterization have elucidated many difficult problems in the pathologic anatomy and physiology of congenital heart disease. As is true of any new technical procedure that is added to our diagnostic armamentarium, the newer methods may increase our ability to interpret the conventional clinical and roentgen studies so as eventually to decrease further our reliance on these more involved technics. The tremendous increase in experience obtained in recent years in the larger centers with these "rare" conditions is having the same effect; in any such mate-

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rial, however, there is inevitably a small group of cases demanding angiocardiography and catheterization. For certain investigative purposes these methods are indispensable.

The following review will be primarily concerned with the roentgen findings in the tetralogy of Fallot and its variants, in patent ductus arteriosus, and in coarctation of the aorta, with a consideration of some of the entities of importance in differential diagnosis. The usual classification into cyanotic and acyanotic groups is adhered to, since knowledge of the presence or absence of cyanosis is fundamental in any attempt to interpret the roentgen findings.

CONGENITAL HEART LESIONS OF INFANCY

The cardiac silhouette in the infant is usually of relatively little help in reaching a specific diagnosis. The heart may rarely be within normal limits in the presence of severe anomalies. Usually there is more or less enlargement of globular, non-characteristic type. In some instances the presence of pulmonary stenosis or atresia may be indicated by a deeply concave pulmonary artery segment, and when this is combined with right ventricular enlargement, a typical *coeur en sabot* may result. It is usually impossible to make an anatomical diagnosis with any great confidence in the infant without recourse to angiocardiography (5). Taussig (21), however, describes a number of roentgenologic features in certain forms of congenital heart disease in infants which, when well defined, may be diagnostic. For instance, according to Taussig, persistent truncus arteriosus may be suggested by a large aortic knob and absence of the pulmonary artery shadows; the anterior protrusion of the right ventricle in the left anterior oblique view may produce a unique shelf-like appearance. Transposition of the great vessels may be indicated by a narrow vascular pedicle in the postero-anterior view, the great vessel shadow appearing wider in the left anterior oblique view.

Beyond the age of two years the diagnostic possibilities are greatly limited, since the great majority of patients with the more complex and serious anomalies die during infancy. Furthermore, surgery is at present preferably deferred until after infancy. Thus, for the present presentation the practical problem is confined to the relatively few possibilities that occur with frequency after the age of two years.

CYANOTIC GROUP

Tetralogy of Fallot: The majority, probably about 70 per cent (2), of cases of cyanotic congenital heart disease with survival beyond infancy are examples of the tetralogy of Fallot, *i.e.*, pulmonic stenosis, dextroposition of the aorta, high interventricular septal defect, and hypertrophied right ventricle. There are no definitive clinical findings. The roentgen findings, while sometimes quite typical, more often serve principally to weed out examples of rarer malformations in which the picture deviates from that seen in the tetralogy of Fallot and which may not be suitable for surgical treatment.

The classic roentgen picture in the tetralogy of Fallot consists of a "sabot" or "sheep-nose" heart contour in the frontal view, with prominence of the left lower pole; that the latter is due to the *right* ventricular hypertrophy is proved by the anterior protrusion of the ventricular mass in the lateral and oblique views. The heart is very rarely much enlarged. The small size of the pulmonary artery and its branches is reflected in the deeply concave pulmonary artery segment on the left heart border and in abnormally small hilar vessel shadows. The decreased prominence of fine lung vessels creates the so-called "anemic" appearance of the lung fields.

The absence of one or all of these features by no means excludes the diagnosis of tetralogy of Fallot in a patient cyanotic from birth. A review of 50 cyanotic cases submitted to surgery for performance of the Blalock anastomosis at the University of Minnesota Hospitals showed a well defined *coeur en sabot* in only 14. (The clinical

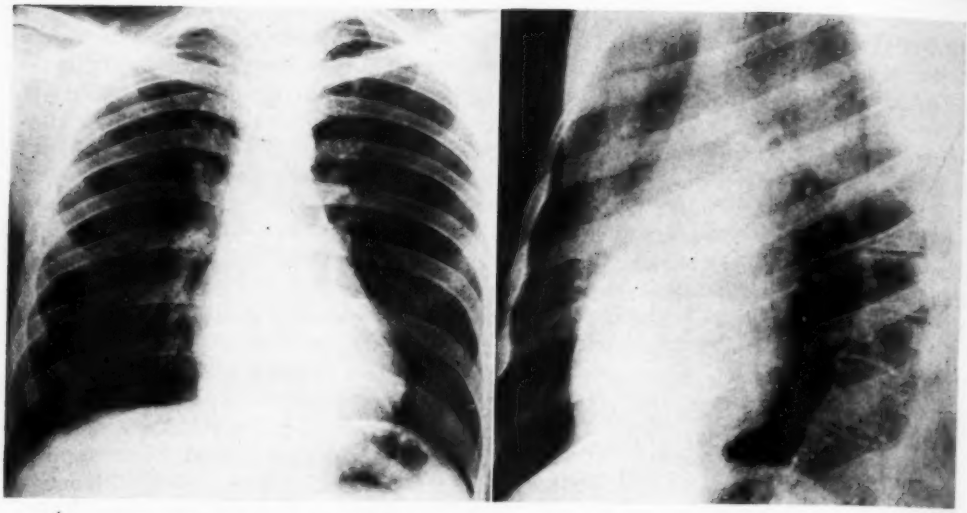

Fig. 1.—Tetralogy of Fallot with minimal roentgen findings. Male, 25 years of age, cyanotic from birth; EKG, right axis deviation. *Autopsy:* Tetralogy of Fallot.
Frontal View: Slight enlargement of heart to left (right ventricle). Left aortic arch. Small hilar vessels.
Left Anterior Oblique View: No definite evidence of right ventricular enlargement.

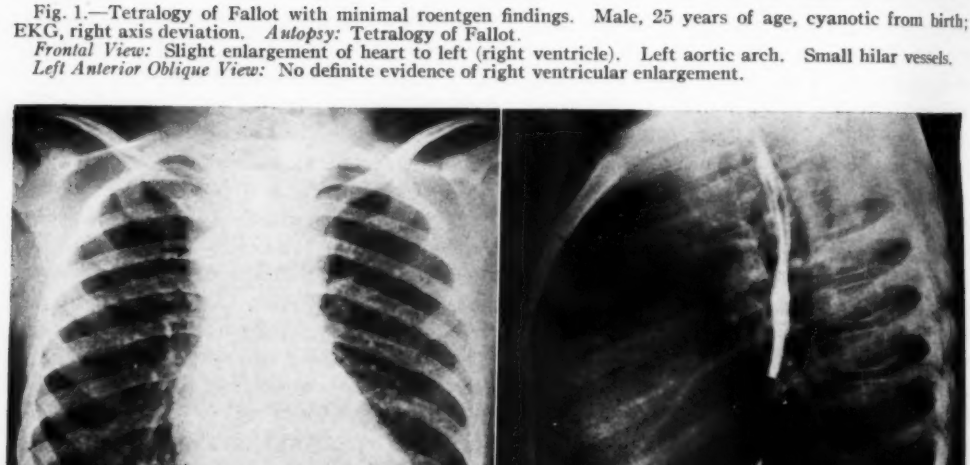

Fig. 2. Tetralogy of Fallot with non-characteristic silhouette and increased small lung vessels. Female, 6 years of age, cyanotic from birth; EKG, right axis deviation. Good response to Blalock operation; probable tetralogy of Fallot.
Frontal View: Straight left heart border, notch at level of pulmonary artery segment. Right aortic arch (arrow). No large hilar arteries. Greatly accentuated network of small lung vessels due to collateral arterialization (demonstrable in original roentgenogram).
Lateral View: Large right ventricle fills the retrosternal space. Right aortic arch does not displace esophagus anteriorly, indicating upper descending aorta is on the right (usual type of right aortic arch in the tetralogy of Fallot).

and surgical aspects of these cases have been reviewed elsewhere, 15, 22.) In 11 cases the silhouette approximated the normal except for evidence of right ventricular enlargement in the oblique views. In Figure 1 is illustrated a case, verified at autopsy, with a nearly normal silhouette.

The remaining 25 cases of this series can be classed as an intermediate group, with a more globular silhouette and less concavity of the pulmonary artery segment than is generally considered characteristic of the tetralogy of Fallot. There was usually in this group little or no evidence of the elevation of the cardiac apex which is a feature of the *coeur en sabot* silhouette. In some instances the left heart border was quite straight with, however, a small but definite "pulmonic notch" separating the left aortic knob from the lower left border. Figure 2 displays this straight left border without elevation of the cardiac apex; in this instance there is a right aortic arch.

In a few of the 50 cases the diagnosis was substantiated at autopsy; in a majority of the others it was proved from a practical point of view by a satisfactory clinical response to the anastomosis. It is recognized that examples of some of the other anomalies that benefit from the Blalock procedure may be represented in this latter group. Two of the patients with noncharacteristic silhouettes were proved at autopsy to have underdeveloped right ventricles and atrial septal defects, one having tricuspid and pulmonic atresia, the other tricuspid and pulmonic stenosis; both might have benefited from the anastomosis could it have been achieved.

In most of the cases the hilar shadows or the intrapulmonic finer vessels, more often both, were decreased in size. In 10 cases, however, with small or normal appearing hilar vessels the finer pulmonary artery branches in the lung fields were accentuated (Fig. 2, frontal view). This accentuation is attributed to the presence of collateral arterialization of the lungs. It is important to recognize that this not uncommon increased prominence of the finer vascular pattern of the lung fields does not exclude the diagnosis of pulmonic stenosis. The heart and pulmonary arteries regularly appear hypoactive as observed fluoroscopically.

A *persistent right-sided aortic arch* is a common associated anomaly, present in about one-fifth of the cases of tetralogy of Fallot (10). This independent anomaly is unrelated to the basic dextroposition of the aorta whereby the aortic orifice overrides the ventricular septal defect. A right-sided arch was present in 12 of our 50 cases. In only one of these was there displacement of the esophagus anteriorly at the arch level, such displacement indicating either a high crossing of the aorta, with the descending aorta on the left, or an aortic diverticulum. The right aortic arch in the tetralogy of Fallot is usually of the type in which the aorta descends on the right, crossing at a lower level to pass through the left-sided diaphragmatic hiatus; there is ordinarily no anterior displacement of the esophagus. A large vascular imprint on the posterior aspect of the esophagus at the arch level indicates either that the aorta crosses high, at the level of the arch, or else that a dorsal diverticulum of the right descending aorta is present from which the left subclavian artery arises; in either case the left innominate artery, usually present in the tetralogy with a right-sided aortic arch, will probably be absent. (The innominate artery is usually on the side opposite that on which the descending aorta lies.) Since the subclavian artery, which is a branch of the innominate, is generally preferred for the anastomosis (2), the roentgenologist must be prepared to inform the surgeon not only as to the side on which the arch is located but, in addition, the side on which the aorta probably descends.

The demonstration of a right-sided aortic arch (with a normal situs of the heart) in a cyanotic patient increases the likelihood that the tetralogy of Fallot is present.

Following a successful systemic-pulmonary artery anastomosis, the heart in some instances enlarges and the pulmonary arteries become larger and fluoroscopically appear active; progressive cardiac enlarge-

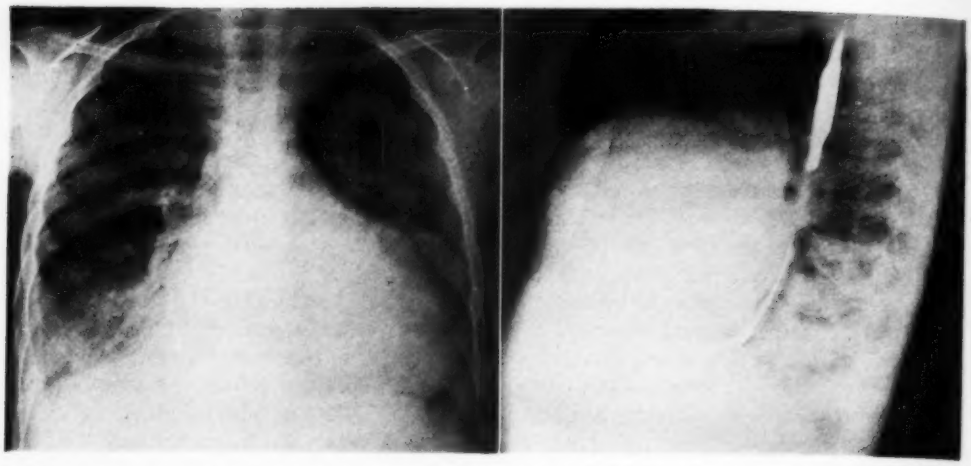

Fig. 3. Pure pulmonic stenosis. Male, 12 years of age, with marked dyspnea from age of three years; not cyanotic. Right heart failure terminally. *Autopsy:* Isolated pulmonic stenosis; hypertrophied right ventricle.
Frontal View: Very large globular heart. Pulmonary artery segment *not* concave. Basal density in lungs probably edema; right pleural effusion.
Lateral View: Large right ventricle anteriorly.

ment and failure are uncommon (20) and have not occurred thus far in our cases.

Tricuspid Atresia: In occasional cases of cyanotic congenital heart disease there is an underdeveloped right ventricle with tricuspid and pulmonic atresia or stenosis. There is usually an interatrial or interventricular septal defect. The roentgen appearance is not unlike that in the tetralogy except that the prominence of the left lower pole of the heart in the frontal view may be shown in the left oblique view to represent the left ventricle rather than the right. The electrocardiogram accordingly shows left, instead of right, axis deviation. The circulatory physiology in most of these cases is such that a Blalock procedure may be expected to be beneficial. In our material there was one case with left axis deviation; this patient responded well to the anastomotic operation.

Cases of *persistent truncus arteriosus* will be very rarely encountered and will probably be positively recognized only by angiocardiography. In some of these where the circulation to the lungs is by way of bronchial arteries and a pulmonary artery exists, surgery may be feasible and of benefit. To establish this situation, recourse to surgical exploration will probably be required. In the rare examples of *transposition of the great vessels* and of *single ventricle* with survival beyond infancy, marked cardiac enlargement may be anticipated. Here again, diagnosis and surgical prognosis depend upon the more complex methods of examination.

Cardiac Malformations Not Regularly Producing Cyanosis

Eisenmenger's Complex: Rarely a case will be encountered in which the anatomical defects of the tetralogy are present with the exception of pulmonic stenosis. In these instances of Eisenmenger's complex there is no insufficiency of the pulmonary circulation and the creation of a systemic-pulmonary artery shunt probably will be of no avail. Cyanosis is ordinarily less severe than in the tetralogy and usually is not present from birth, but develops sometime after infancy. The presence of a large pulmonary artery and large, active pulmonary artery branches suggests this diagnosis; the heart is usually only moderately enlarged. In borderline cases, catheterization may provide the answer if the catheter can be introduced into the pulmonary artery and an elevated pulmonary artery pressure is recorded.

Isolated Pulmonic Stenosis: Pulmonic stenosis without an interventricular septal defect is a rather rare lesion (7). In such cases there is often an associated interatrial septal defect. In the absence of an atrial septal defect, there is no mixing of the circulations and no cyanosis, so that a systemic-pulmonary shunt would not be beneficial. The right ventricle is greatly enlarged and the heart is unusually large and globular. The pulmonary artery segment is not concave as it is in the tetralogy, the stenosis often being at the pulmonic valve rather than in the conus, and the aorta not being transposed; post-stenotic dilatation of the pulmonary artery may contribute further to fullness of the second left arc of the silhouette. These features in a case of pure pulmonic stenosis are shown in Figure 3. In the absence of an interatrial septal defect to permit a right-to-left shunt of blood, a significant degree of cyanosis only occurs terminally.

Extracardiac Causes of Cyanosis

Pulmonary arteriovenous aneurysms are being recognized more frequently as causes of cyanosis. Roentgenologically, a circumscribed, pulsating vascular mass in the lung often identifies the lesion in these cases. *Pulmonary arteriosclerosis*, producing the cor pulmonale, is a well recognized cause of cyanosis developing in later life; we have seen one case, verified at autopsy, in a child four years of age.

In *summary* it may be said that, since the fundamental indication for the Blalock procedure is the presence of a tetralogy of Fallot, any gross deviation from the roentgen findings described above for this condition, particularly the presence of marked cardiac enlargement and enlarged and active pulmonary arteries, is evidence that surgical treatment may not be of value. In such cases, catheterization and angiocardiography may occasionally reveal a situation that is amenable to surgery. It is again to be emphasized, however, that absence of the classical *coeur en sabot* by no means excludes the diagnosis of tetralogy of Fallot. The heart may be somewhat globular or the left border may be straight, with usually a small notch at the site of the pulmonary artery segment. Increased prominence of the fine vascular pattern in the pulmonary parenchyma, due to the presence of collateral vascularization, is not infrequent in the tetralogy of Fallot.

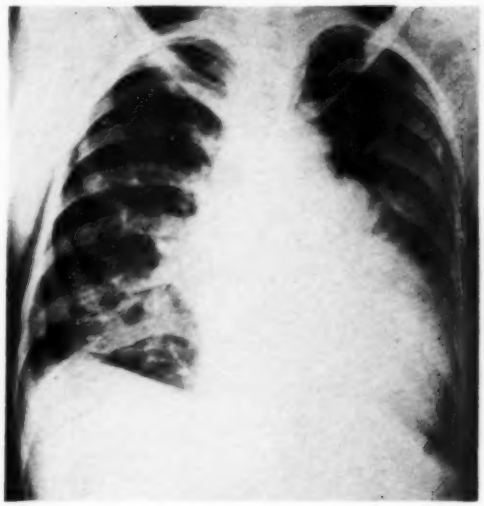

Fig. 4. Patent ductus arteriosus with marked cardiac enlargement. Female, 31 years of age. Typical machinery murmur; blood pressure 120/60 mm. Hg; EKG, "evidence of combined heart strain". Subacute bacterial endocarditis; pulmonary infarcts. Large (2 cm. diameter) patent ductus arteriosus found on surgical exploration.
Frontal View: Very large heart and pulmonary arteries. Aorta of normal caliber (arrow). Scoliosis.

ACYANOTIC GROUP

Patent Ductus Arteriosus: The roentgen findings in patent ductus arteriosus (9), while often suggestive, are not diagnostic in themselves. In the great majority of cases a typical machinery murmur is present. The roentgen findings were reviewed in 90 cases explored in the University of Minnesota Hospitals for correction of a patent ductus arteriosus; only one patient in the group proved not to have this lesion. The murmur in this instance was considered atypical preoperatively. In our experience the roentgen findings were chiefly of value to corroborate the clinical diagnosis and to aid in excluding other malformations.

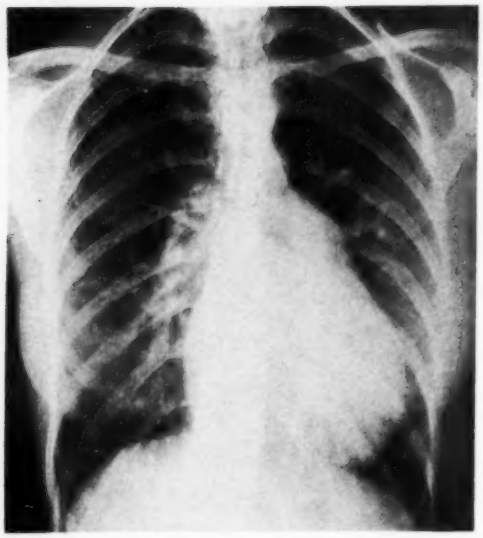

Fig. 5. Interatrial septal defect. Female, 20 years of age, of small stature. Systolic murmur, not characteristic; EKG, right axis deviation. *Autopsy:* Interatrial septal defect.
Frontal View: Globular enlargement of heart due to large right ventricle. Very large pulmonary artery and branches; diminutive aorta (arrow).

There is usually some increase in the size of the pulmonary artery; prominence of the pulmonary artery was absent in only 5 of our cases. Fluoroscopically the heart and aorta appear hyperactive and the pulmonary arteries share in this activity.

The heart is seldom greatly enlarged. In our material 10 per cent of the cases showed marked cardiac enlargement and very large hilar vessels associated with the finding of a large ductus arteriosus at surgery (Fig. 4). Enlargement of the left ventricle was usually predominant. With rare exceptions, the electrocardiogram showed no axis deviation. Alteration in the peripheral pulse is usual and may be very helpful in establishing the diagnosis; the diastolic pressure is low, the pulse pressure increased.

Displacement of the esophagus, usually slight, indicating some enlargement of the left atrium, was present in 25 of the 90 cases. It is important to note the frequency of this finding (9), so that it is not interpreted as evidence against the diagnosis of patent ductus arteriosus.

The normal caliber of the aortic arch can usually be appreciated (Fig. 4), although a very large pulmonary artery may sometimes overshadow it. This is in contrast to the hypoplastic aorta commonly accompanying interatrial septal defect.

In occasional cases, particularly where the murmur is not of typical machinery character and the roentgen findings are equivocal, the identification of a patent ductus arteriosus may require the data from heart catheterization. Aortography per catheter (14), also, may be of value in obscure cases, especially when a patent ductus arteriosus is suspected in the presence of other congenital heart lesions.

Following surgical interruption of a patent ductus arteriosus, the enlarged heart and pulmonary arteries regularly become smaller and less active.

Interatrial Septal Defect: The roentgen picture in interatrial septal defect (1) may closely simulate that of patent ductus arteriosus except that there is marked right ventricular enlargement with no evidence of increase in the size of the left ventricle. The electrocardiogram shows right axis deviation. The pulmonary arteries are regularly of large size and often are of aneurysmal proportions; their hyperactivity, as observed fluoroscopically, is usually more pronounced than that seen with a patent ductus arteriosus. When there is associated mitral stenosis (the Lutembacher syndrome), enlargement of the left atrium may be present, though this is less marked than might be anticipated, apparently because of decompression through the septal defect.

An important distinguishing feature of atrial septal defect is the diminutive aortic arch (Fig. 5). The aortic arch, as has been noted, is of normal size in uncomplicated patent ductus arteriosus.

Isolated Interventricular Septal Defect: A clinical diagnosis of interventricular septal defect is frequently made. The roentgen appearance of the heart in the majority of these cases is within normal limits, though the murmur may be loud and characteristic. In rare instances in which the

defect is large, the appearance of the enlarged heart and pulmonary arteries may mimic that seen in patent ductus or atrial septal defect.

Congenital or acquired aortic stenosis and regurgitation may be considered in the differential diagnosis of patent ductus arteriosus since the to-and-fro murmur present may occasionally suggest the machinery type and there may be an increased peripheral pulse pressure. The roentgen findings, however, are characteristic of an aortic lesion with an enlarged and dynamic left ventricle and ascending aorta; there are no changes in the lesser circulation.

Coarctation of the Aorta: In the few cases of coarctation of the aorta operated upon to date in the University of Minnesota Hospitals and in a considerable group not operated upon in which roentgen studies were available for review, one or more of the classic roentgen findings (17) were present, namely: left ventricular enlargement, rib notching, and an inconspicuous aortic knob. None of these was uniformly present, however, and it is notable that there may be no distinguishing roentgen features, especially in children. The aortic knob may be small even in the presence of a widened ascending aorta. In older individuals the aortic knob may be quite prominent. In some instances, the dilated left subclavian artery may simulate the aortic knob (11); such dilatation was observed (Fig. 6) in the case of an asymptomatic male of thirty-seven with the diagnostic findings of hypertension in the arms, low blood pressure in the legs, evidence of collateral circulation over the back, and with left ventricular enlargement but no rib notching. This dilatation of the proximal portion of the left subclavian artery, when it can be recognized, provides an additional sign of coarctation of the aorta which may be helpful when other roentgen evidence is equivocal.

In the left anterior oblique view the posterior portion of the aortic arch is commonly indistinguishable when coarctation of the aorta is present. In this view several of our cases showed a notched shadow with the peak of the notch directed anteriorly at the level of the dorsal portion of the aortic arch. This shadow appeared to represent, as suggested by Gladnikoff (11), the posterior borders of the dilated left subclavian artery and the aorta with the notch at their junction.

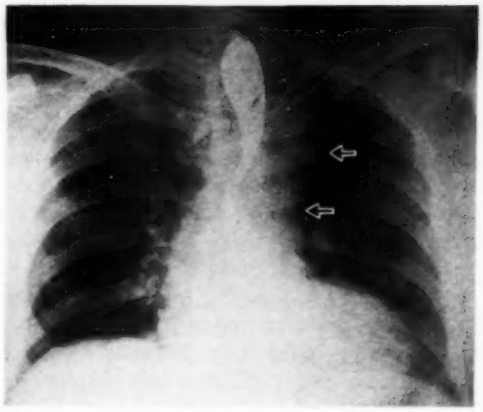

Fig. 6. Coarctation of the aorta with dilated left subclavian artery but no rib notching. Male, 37 years of age, with no symptoms. Blood pressure; arm 160/100; leg 90/? mm. Hg. Murmurs over collateral vessels of back. *Clinical Diagnosis:* Coarctation of aorta.

Frontal View: Left upper mediastinal mass noted in roentgen chest survey; marked pulsations fluoroscopically; dilated left subclavian artery (upper arrow). Post-stenotic dilatation of descending aorta (lower arrow). Enlarged left ventricle. Absence of rib notching.

To visualize the length of the narrowed segment of aorta, some form of aortography will be required (4).

SUMMARY

1. Cases of the *tetralogy of Fallot* may show the classical *coeur en sabot*, some modification of this, or a practically normal cardiac silhouette. Marked enlargement militates strongly against this diagnosis. The peripheral vascular markings in the lungs may be increased. The heart and hilar vessels appear hypoactive fluoroscopically. In *tricuspid atresia*, also amenable to surgery by the systemic-pulmonary artery anastomosis, the silhouette is similar, but with left, instead of right, ventricular enlargement.

2. In *patent ductus arteriosus*, prominence of the pulmonary artery is the rule.

Marked cardiac enlargement is unusual. Some degree of left atrial enlargement is frequent. If ventricular enlargement is obvious, that of the left ventricle predominates. The aorta is of normal caliber. The heart and pulmonary arteries appear hyperactive fluoroscopically. (In interatrial septal defect, enlargement is primarily of the right side of the heart; the aorta is hypoplastic.)

3. Dilatation of the proximal portion of the left subclavian artery may be visible in *coarctation of the aorta* and may simulate the aortic knob, which is usually inconspicuous. Such dilatation may be a helpful roentgen sign when rib notching is absent.

4. Our experience indicates that in the majority of cases of congenital heart disease a satisfactory diagnosis for purposes of prognosis and of selection of cases for surgery can be made, after infancy, by judicious correlation of the findings of the ordinary roentgenologic and clinical methods of examination. For practical clinical purposes, angiocardiography and heart catheterization may be reserved for selected obscure cases.

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SUMARIO

El Examen Roentgenológico Convencional en las Cardiopatías Congénitas Operables

De su experiencia, deduce el A. que, en la mayoría de los casos de cardiopatía congénita, cabe hacer, después de la infancia, un diagnóstico satisfactorio para fines de pronóstico y de selección de casos para intervención cruenta, mediante la juiciosa correlación de los hallazgos obtenidos con las ordinarias técnicas radiológicas y clínicas de examen. Para fines clínicos prácticos, pueden reservarse la angiocardiografía

y el cateterismo cardíaco para ciertos casos oscuros selectos.

Los casos de *tetralogía de Fallot* pueden revelar el clásico *coeur en sabot*, alguna modificación del mismo o una silueta cardíaca prácticamente normal. Una hipertrofia pronunciada milita poderosamente contra dicho diagnóstico. Las marcas en los vasos periféricos de los pulmones pueden acentuarse. El corazón y los vasos hiliares parecen hipoactivos al roentgenoscopio. En la *atresia tricúspide*, que también es cohibible con la anastomosis arteria pulmonar-somática, la silueta es semejante, pero la hipertrofia corresponde al ventrículo izquierdo, y no al derecho.

En el *conducto arterioso permeable*, la prominencia de la arteria pulmonar es lo habitual. La hipertrofia cardíaca pronunciada es rara, pero es frecuente observar alguna hipertrofia de la aurícula izquierda. Si la hipertrofia ventricular es manifiesta, predomina la del lado izquierdo. La aorta muestra calibre normal. El corazón y las arterias pulmonares parecen hiperactivos al fluoroscopio. (En la deformación del tabique interauricular la hipertrofia corresponde primordialmente al lado derecho; la aorta es hipoplásica.)

En la coartación de la aorta, la dilatación de la porción proximal de la arteria subclavia izquierda puede ser visible y simular prominencia aórtica, la que suele ser poco distinguible. Esa dilatación puede constituir un útil signo roentgenológico si falta la escotadura costal.

DISCUSSION

(Papers by Shapiro; Peck and Wilson; Stauffer)

E. Holman, M.D. (San Francisco): As surgeons, we are interested in accurate diagnosis, but we are also interested in determining what patients will be benefited by operation, particularly in the case of the tetrad of Fallot by an artificial patent ductus, and, of course, in the case of a patent ductus by its closure.

We have had considerable experience with these lesions, but we have had our difficulties. We're not quite as infallible as Dr. Shapiro with a 0.5 per cent error. I should like to present a few cases to illustrate some of the difficulties that may be encountered.[1]

The first case is that of a young man of four and half years with a typical Fallot appearance of the heart. The angiocardiogram shows a little blunted pulmonary artery and a large aorta overlying the two sides of the heart. At operation, which was performed on both sides in an effort to find a pulmonary artery, numerous collateral vessels were encountered across the mediastinum to the lung, but there was absolutely no pulmonary artery that we could use. This boy is still living eighteen months after his two operations and, curiously enough, he is improving, I presume because of a greater development of collateral vessels.

Another boy at five and a half presented a history of cyanosis from birth with a high red blood count (nine and a half million), but he had a left axis deviation, and the heart did not have the Fallot configuration. It was thought from the evidence at hand that this might be a tricuspid stenosis. At any rate, the Blalock procedure was performed, and one of our best results attained. The child is perfectly normal at present.

One might be led astray by the atypical roentgenographic picture in a cyanotic young man of eighteen years who had such respiratory difficulty crossing a street that he had to squat two or three times in heavy traffic. At operation a large pulmonary artery was found—1.7 cm. in diameter—with a pressure of over 400 mm. of water, and yet we performed the Blalock procedure and an excellent result was obtained. The patient no longer squats, he has a job, and is very happy. We don't know exactly what he has, but he has been benefited by the operation.

Another patient, a five-year-old, had a little jutting lesion. She was cyanotic, however, and we thought that she would be benefited by the operation. She is a perfectly normal looking child at the present time. Therefore, don't be too misled by the appearance of a heart like that.

I should like to ask Dr. Shapiro (we might have sort of a little clinical-pathological conference), what the heart which I am about to show suggests to him.

Dr. Shapiro: I'd like to have some clinical findings. I never make a diagnosis on a film alone.

Dr. Holman: The patient is sixteen years old and has been short of breath and mildly cyanotic since birth. About six weeks before she entered the hospital, she became more cyanotic and more

[1] Slides were shown at this point.

dyspneic. She was admitted in heart failure. The blood pressure was 110/90, the red blood count six million, hemoglobin 116 per cent. A marked right axis deviation was present. It appears to me that that looks like one of your cases of interventricular septal defect.

Dr. Shapiro: Were the pulmonary vessels enlarged and pulsating?

Dr. Holman: The patient was so sick that we couldn't put her in front of a fluoroscope.

Dr. Shapiro: It looks pretty promising for an interventricular septal defect if there were no cyanosis.

Dr. Holman: There was cyanosis, though, with six million red cells and hemoglobin of 116.

Dr. Shapiro: She didn't have a patent ductus arteriosus, did she? I imagine that you probably will tell me that she did. However, I would say that she did not, but I would wait and study the case longer. I operate only on patients that I am sure are of this type.

Dr. Holman: Unfortunately, she died.

Dr. Shapiro: She would have died anyhow.

Dr. Holman: It was a case of heart failure. The patient was sent to us with a diagnosis of patent ductus arteriosus. In our superior wisdom, we said that it wasn't a patent ductus arteriosus but a patent auricular septal defect. At autopsy we found a greatly enlarged right auricle and a greatly enlarged pulmonary artery. The only lesion present was a patent ductus, 0.5 cm. in diameter, easily dilated to a centimeter. The right ventricle weighed 167 gm. and the left ventricle only 78 gm. The pulmonary artery was thicker than the aorta. There was marked sclerosis of the end arteries in the lungs. This is one of the cases which I believe Dr. Shapiro said he has never seen—a patent ductus with cyanosis, right axis deviation, large right heart, and a large right auricle. All evidence indicates that part of the total blood volume was flowing into the pulmonary artery, through the patent ductus into the systemic circulation, back through the right heart, and again into the pulmonary circuit, thus by-passing the left heart. A much greater blood volume, therefore, was flowing through the right heart than through the left heart, and the response to this increased flow of blood was, of course, a preponderant development of the right heart.

Henry S. Kaplan, M.D. (San Francisco): I think that we have all been privileged to hear a most stimulating and informative group of papers, including the remarks that Dr. Holman has just added. With a group of such closely integrated presentations, it seems pointless to discuss each separately, and I should like to dwell on only one or two matters that have come up.

We are concerned here, partially, with trying to assess the place of conventional radiography and fluoroscopy as opposed to the use of special procedures in the differential diagnosis of congenital cardiac lesions. I think that we would all agree with Dr. Shapiro that in the vast majority of typical cases, there is no serious problem involved, and the conventional technics are perfectly adequate. However, it would seem, on analysis, that one group of discussants has been talking about the types of cases that one is likely to encounter in ordinary clinical practice, while in Dr. Wilson's presentation, I believe that the major emphasis was upon a large case-finding program, under which circumstances we see cases that do not fall into the typical categories.

First of all we see atypical variants of the usual malformations. They are atypical as a result either of abnormal or unusual clinical findings, or of the presence, as Dr. Holman has shown, of roentgen findings that do not conform. Secondly, we see peculiar and bizarre combinations of the ordinary types of lesion, and any type of combination inevitably obscures the picture very, very seriously. Finally, surprisingly enough, we see many more cases of the extremely rare conditions—those that just a few years ago were listed in very fine print at the bottom of the page in papers concerned with this subject. When we get into this general category, we find very promptly that conventional radiography is not enough. I do not mean to give the impression that the special procedures are always enough either. There is a group of cases, still regrettably large, in which not only will conventional radiography miss the diagnosis but special procedures, particularly angiocardiography and cardiac catheterization, will also fail to give the correct answer. There is no Utopia yet in this field. Nevertheless, in a sizable percentage of cases in the group of which I am talking, a significant degree of help will be offered, and a very significant improvement in the accuracy attained, by the addition of such special procedures as angiocardiography and cardiac catheterization.

This applies to the cases that we have seen today, but I think it is also important to look to the future. A backward glance is sufficient to make us all realize that just ten years ago this subject was a mystery, and a rather exotic one for most people, for we lumped all cases of congenital heart disease into one basket. Today, we are trying to differentiate lesions that formerly were of no clinical significance at all, because they could not be operated upon. I think that it would not be wise to keep our horizons low. We must look forward to at least as great advances in surgery as have been made in the last ten years. As to what is being accomplished today, I think

that the operations for patent ductus and for coarctation of the aorta seem perfectly logical and adequate procedures, but those for the cyanotic group of diseases are merely palliative; they do not answer completely the needs of the heart.

The recent developments in cardiac surgery in Sweden and elsewhere should suggest to us the possibility at least of operations upon the heart with actual repair of the lesions themselves, rather than mere palliative procedures. If this does become possible, it will be necessary for the radiologist to provide increasing accuracy in the differentiation of these lesions, and this differentiation must be made in infancy before excessive damage to the heart has occurred. We are going to be forced to deal with younger and younger patients in whom, today, conventional work finds its greatest sphere of difficulty. I feel, therefore, that if we are forced to prophesy about the future place of special procedures in the differential diagnosis of these lesions, it is evident that there is a trend toward an increasing sphere of legitimate usefulness for these procedures. At the same time we must caution against their indiscriminate use in cases where careful study and collaboration by intelligent cardiologists and roentgenologists may solve the problems of differential diagnosis by conventional technics.

Dr. Hodges: I would like to ask one question for my own information. If Dr. Holman's final patient had reached surgical operation, what would he have done—closure without alteration, division of the ductus, or the Blalock procedure to increase the right-to-left shunt? And, further, wasn't Dr. Shapiro's recommendation to observe the patient longer before making up his mind well advised?

Dr. Holman: I would say that Dr. Shapiro was perfectly right in wanting to make a longer observation. However, it would have failed, as it was the right ventricle of the patient.

Dr. Shapiro: I would like to say, also, Dr. Holman, that there are lots of things that I haven't seen yet. My experience with congenital heart disease has been limited mostly to children of school age over a period of about twenty-six years. I have followed a group of cases with congenital heart disease, some of them for as long as twenty years, and I want to tell you as a clinician that many of those patients do not get into such serious trouble as we are led to believe. If you follow the cases with cyanosis, say in children one and two years of age, you don't have to be in a tremendous rush to operate. Many of them live to school age, when they are much easier to handle. Why not wait until they grow up a little bit and surgery will be more successful and you can make a better diagnosis?

With intraventricular and intra-auricular septal defects, a great majority of patients will get along well unless the defects are large. One is able to tell this early, however, for by the time school age is reached the heart will already be big. If the heart is not large by that time, in most cases it will not become so as the child grows older.

I would say that my own feeling is that this whole field is so new to most clinicians and to most roentgenologists that we are jumping at conclusions without taking the time to study our patients over a long enough period.

Dr. Stauffer (closing): Just briefly, in closing, I might say that I am sort of a reluctant dragon in this discussion as one of the younger members of our diagnostic team. I have been very enthusiastic about using some of the more elaborate methods. We are, of course, beginning to institute catheterization and angiocardiography. I have been much impressed, in spite of my scepticism, with the results obtained from the less complex procedures. I have been stimulated by Dr. Shapiro's experience and these results that we have reported, particularly with the Blalock procedure, where there have been no really serious mistakes I think that it should be emphasized that one of the things that we have tried to bring out is that the boundaries of the "typical" case should be expanded considerably.

One other thing that I wanted to point out is that we should stimulate the radiologist not connected with a big center not to be depressed about the diagnosis of congenital heart disease so that he throws up his hands and decides that every case has to be referred elsewhere. Certainly, by applying these methods that we have outlined and that Dr. Wilson has mentioned, it is possible to achieve at least a rough practical classification in these cases. It seems to me that cardiac surgery in most cases could be allowed to wait until the patient is several years of age, at least in the cyanotic group. If the heart is going to enlarge, the chances are that the surgeon won't want to produce the additional load of an artificial patent ductus arteriosus.

Some Clinical Applications of Electrokymography

The Findings in Myocardial Infarction and Heart Block[1]

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THE STUDY OF cardiac pulsations by fluoroscopy and roentgenkymography has contributed interesting data regarding the physiology of cardiac contraction both in the normal and in such abnormal states as valvular heart disease, myocardial disease, and pericarditis. Analysis of the movements of the aorta, pulmonary artery, and other great vessels also is of some value in the differential diagnosis of aortic aneurysm and mediastinal tumor. The usefulness of roentgenkymography is limited, however, by several inherent technical difficulties which detract from its clinical application and popularity. For example, since the amplitude of movement of the heart borders is not magnified, the recorded movement is often small and difficult to analyze. If a larger or spread-out tracing is desired, the time of exposure during which the cardiac movement is recorded must necessarily be short, ranging from 1 to 1.5 seconds. This limits the study of cardiac movement in bradycardia and the arrhythmias.

With the development and clinical application of electrokymography both of these drawbacks of roentgenkymography are overcome (1, 2). Electrokymography permits adequate magnification of cardiac movement, while the duration of the actual recording over any segment of the heart border is limited only by the safety considerations of fluoroscopy. Perhaps of greatest importance is the fact that electrokymography lends itself easily to the simultaneous recording of cardiac movement, the electrocardiogram, arterial or venous pulse, and the phonocardiogram. This permits correlation with these better known manifestations of the events in the cardiac cycle and leads to greater accuracy in interpretation.

In our work, the movement of the various segments of the heart border is recorded simultaneously with an electrocardiographic lead, the carotid pulse or apex beat, and the phonocardiogram. Our apparatus and methods are similar to those described by Henny, Boone, and Chamberlain (1, 3). The kymogram is recorded routinely from the following cardiac segments in the postero-anterior view: arch of aorta, pulmonary artery, left auricular segment, upper, mid and lower left ventricle, right border. Recordings are also made in the left and right oblique views.

In this report, we will illustrate the clinical application of electrokymography in three cases of myocardial infarction. The physiologic potentialities of the method will be illustrated by an analysis of the records in two cases of heart block.

MYOCARDIAL INFARCTION

The abnormalities in ventricular contraction produced by myocardial infarction have been extensively studied fluoroscopically and roentgenkymographically (4–7). Characteristically there is observed over a segment of the left ventricular contour, and particularly near the apex, a systolic expansion or localized diminution of pulsation. On the roentgenkymogram, systolic expansion is represented as a lateral movement of the left ventricular border at the onset of systole. The border may remain in the lateral position during the entire or greater part of systole, but not infrequently the lateral movement is of shorter duration and occupies only the early phase. In some cases, systolic expansion is manifested

[1] From the Cardiovascular Research Group, The Mount Sinai Hospital, New York. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5–10, 1948.

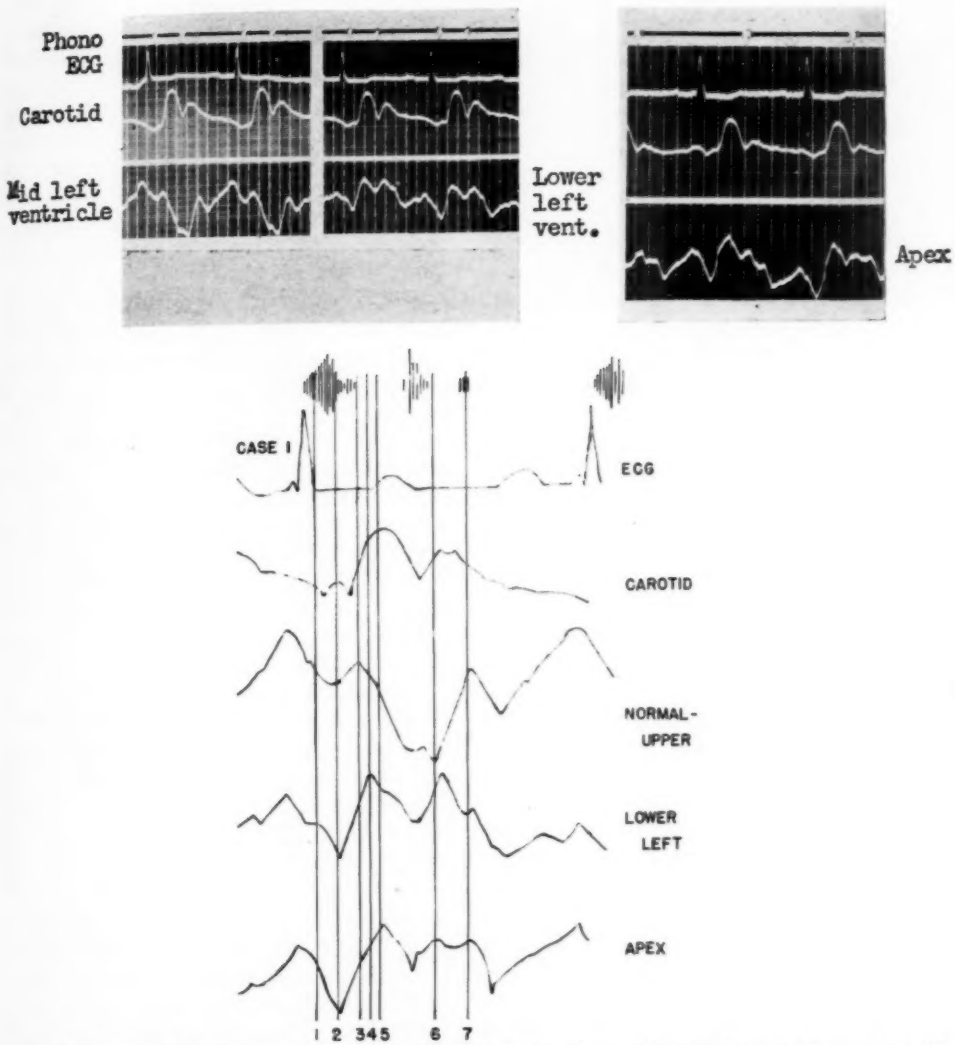


Fig. 1. Myocardial infarction, Case 1. In each tracing, there is recorded the phonocardiogram, carotid pulse wave, one electrocardiographic lead, and the electrokymogram. The lower diagram is a reconstruction. 1. Onset of systole. 2. End of isometric phase. 3. Onset of downward deflection in relatively normal segment. 4. Onset of downward deflection over lower left ventricular segment. 5. Onset of downward deflection over apex. 6. Onset of rapid inflow phase. 7. End of rapid inflow phase.

rather as a delay in the onset of mesial movement.

The appearance of various segments of the left ventricle in a case of myocardial infarction is illustrated by the tracings of Case 1. In this case the kymographic studies of the ventricular pulsations were of distinct diagnostic value, since the presence of the left ventricular infarction could not be established from the clinical evidence.

CASE 1: The patient was a male of 47 years who was first admitted on Oct. 31, 1947, in congestive heart failure. His heart was enlarged to the left. The history suggested the presence of hypertensive heart disease. On admission and throughout his clinical course the blood pressure was 130/100. Roentgenkymograms at this time showed active but apparently normal left ventricular pulsations. The

electrocardiogram revealed left axis deviation and evidence of damaged ventricular muscle. Improvement occurred following digitalization and bed rest.

The patient's second admission was on Jan. 28, 1948, again in congestive failure. The electrocardiogram was not essentially changed.

On March 3, 1948, an electrokymogram demonstrated paradoxical pulsation in the region of the apex of the left ventricle.

The electrokymographic tracings made in the postero-anterior view in this case are presented in Figure 1. Mesial movement of the cardiac border is represented by a downward or negative deflection of the kymographic curve; lateral movement by an upward or positive deflection. It is emphasized that amplitude of deflection as recorded is not necessarily proportional to the actual amplitude of contraction, since the former is entirely under the control of the examiner.

The upper left ventricular border shows a relatively normal configuration and time relation. A large, rapid, negative (mesial) deflection of the ventricular tracing begins at the end of the first sound and 0.02 second after the beginning of the major rapid positive deflection of the carotid pulse. This is 0.20 second after the onset of the QRS and is practically synchronous with the onset of lateral movement of the aorta. The rapid ejection phase, therefore, is not recorded as a mesial movement of the ventricle until about 0.04 second after the beginning of the rapid rise of the carotid pulse (this includes 0.02 second delay for the pulse wave to reach the carotid artery and pass through our recording mechanism). This normal delay is accounted for by recalling that the recorded movement is an algebraic summation of the forces acting on this segment of the heart, with the mesial movement becoming predominant only after 0.04 second (0.02 second on the actual tracing).

Preceding this mesial movement of the left ventricle is a lateral movement which begins 0.12 second after the onset of the QRS. It follows a small positive deflection in the carotid pulse wave and is simultaneous with the second large amplitude component of the first sound. This corresponds to the end of the isometric phase of systole. Allowing for the 0.02 second delay in the carotid pulse recording and accepting the usual interpretation of the phonocardiogram (8), the isometric phase actually begins some 0.07 second before the onset of the lateral movement, when the left ventricular border is moving in a negative deflection. In some tracings there is only a slight change in slope.

In this normal segment, the negative downward deflection in systole is rapid, reaching a nearly maximum position 0.03-0.04 second before the dicrotic notch in the carotid pulse and slightly before the onset of the second sound. The slope of this negative deflection is not continuous, there being a distinct change to a more rapid slope 0.06 second after the beginning of the deflection, or 0.27 second after the QRS. Allowing 0.02 second for delay in recording, this corresponds to the peak of the carotid pulse. After a slight hesitation, the negative deflection reaches its lowermost point 0.43 second after the QRS and just beyond the second sound. This corresponds to the beginning of the rapid inflow phase. The following positive deflection reaches its maximum at the time of the third heart sound and marks the end of the rapid inflow phase.

Over the lower left ventricle, however, the picture is different. There is a definite delay in systolic contraction with what can be considered as systolic expansion in early systole. This tracing (Fig. 1) is analyzed as follows. The earliest negative deflection in systole does not occur until 0.04 second after the end of the first sound and 0.05 second after the beginning of the major positive deflection of the carotid pulse. This is 0.22 second after the QRS. The isometric phase begins with a small negative (mesial) deflection 0.10 second after the QRS as it did in the segment above it, but the negative deflection is small compared with the positive deflection which follows it. The lateral movement continues beyond the onset of the rapid ejection phase.

The negative deflection in the rapid

ejection phase also differs from that in the normal segment. It is much less steep in its early phase and changes slope 0.03 second after it starts. It is interesting that this change in slope occurs 0.27 second after the QRS, or precisely where it did in the normal segment, *i.e.*, at the peak of ejection. In other words there is a return to a normal contraction form in the abnormal segment when the high pressure in the left ventricle begins to drop. It is also of interest that 0.43 second after the QRS where, in the normal segment, there is a positive deflection due to ventricular filling following the opening of the A-V valve, the abnormal segment shows a negative deflection. Apparently even in the rapid inflow phase of diastole the abnormal part of the ventricle acts paradoxically.

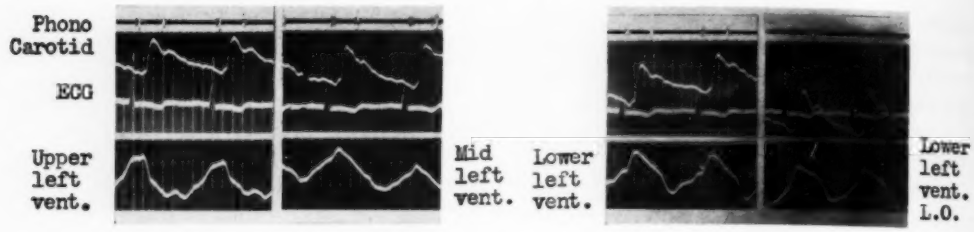
The apical tracing is even more paradoxical. Here the delayed (mesial) negative movement begins 0.09 second after the rapid positive deflection of the carotid pulse and 0.26 second after the QRS. It is well beyond the end of the first sound. In fact, it most nearly corresponds to the peak of the carotid wave or, in other words, the end of the rapid ejection phase. The systolic mesial movement here, therefore, does not occur until at least 0.06 second after its occurrence in the normal upper segment. When there is beginning systolic ejection in the normal segment, there is indeed a positive (upward) deflection lasting 0.08 second at the apex, and this is therefore frank systolic expansion. It is of considerable interest that in this abnormal segment, when the rapid ejection phase ends and the pressure in the ventricle begins to drop, there is an end also of the lateral or expansion movement of the segment.

Paradoxical movement in the rapid inflow phase is again noted, but the reason for this is not clear. The explanation may be related to the fact that, although the ventricular volume increases in this phase, intraventricular pressure does not increase to any great degree. Conceivably an increase in pressure is required to distend the diseased segment.

CASE 2: The patient, a man of 38 years, gave a life-long history of fatigue on mild exertion. During childhood he could never indulge in sports or games because of easy fatigability. He had never experienced chest pain or dyspnea. Physical examination showed an undernourished asthenic male with a heaving precordium and a diffuse apical thrust. A moderately loud rough systolic murmur was audible in the apical region. The electrocardiogram revealed evidence of marked left ventricular enlargement and myocardial damage. Fluoroscopy showed aneurysmal dilatation of the left ventricle and paradoxical pulsation of the lower two-thirds of the left ventricular contour. These findings were confirmed by roentgenkymography. The tentative diagnosis, therefore, was aneurysmal dilatation of the left ventricle due to old infarction. In the absence of a history of coronary occlusion and in view of the life-long history of diminished cardiac reserve, the possibility existed that the ventricular aneurysm was of congenital origin, perhaps on the basis of an aberrant left coronary artery arising from the pulmonary artery.

The electrokymographic tracings are presented in Figure 2. The kymogram recorded over the upper left ventricular border shows a normal configuration and time relation. Negative (mesial) deflection of the ventricular tracing begins 0.15 second after the onset of the QRS and 0.03 second preceding the rapid positive deflection of the carotid pulse. It is beyond the first sound, so that the small positive (lateral) ventricular movement which begins approximately 0.10 to 0.11 second after the onset of the QRS probably indicates the initial part of the ejection phase. It is important, however, to emphasize, as does Stauffer (9), that "electrokymographic curves cannot be accepted uncritically as representing volumetric changes that correlate positively with cardiodynamic events. The great vessel curves and to a much greater extent those from the ventricles are influenced by movements of the heart as a whole."

The major negative (mesial) deflection of the ventricle is practically synchronous with the onset of the positive (lateral) deflection recorded over the aorta. It is a fairly rapid movement in its early phase, but its slope changes after 0.08 second and becomes more gradual until the end of systole. This change in slope is simul-



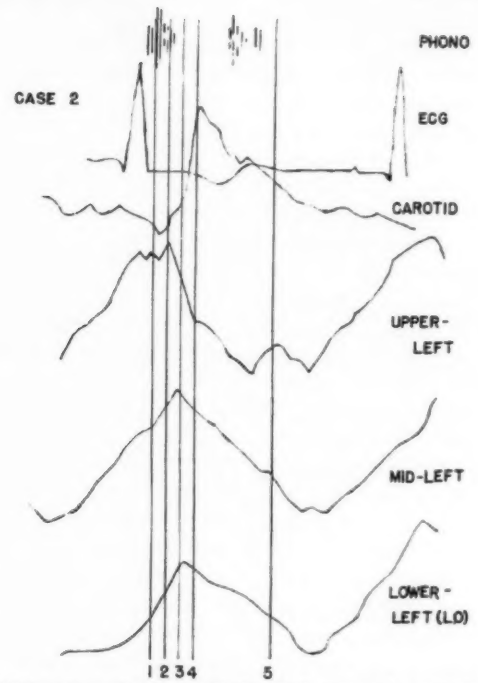


Fig. 2. Case 2. Myocardial infarction with paradoxical systolic expansion over lower left ventricular contour. Numbers refer to phases listed under Fig. 1.

taneous with the corrected peak of the carotid pulse.

The kymogram recorded from the mid left ventricular border shows abnormal ventricular contraction. The early lateral movement is more prominent and is broader. Although the negative (mesial) movement does not appear significantly delayed, beginning approximately 0.15 second after the onset of QRS, the motion is slow and gradual compared with the rapid downward movement of the upper ventricular border. There is practically no change in slope at the peak of ejection. In this tracing the rapid inflow phase also shows a negative rather than a positive deflection.

Kymographic recordings from the lower apical segment of the left ventricle, both in the postero-anterior and left oblique views, are even more suitable to demonstrate delayed systolic contraction. The tracings reveal an abrupt prominent lateral movement beginning at the onset of systole approximately 0.09 second after the onset of the QRS, synchronous with the first sound and the isometric phase of the carotid pulse (after correction for delay in transmission). The early onset of the lateral movement suggests that the para-

doxical ventricular movement begins in the isometric phase when the intraventricular pressure rises suddenly. The lateral movement reaches its peak in early systole, 0.19 second after the QRS. Mesial movement, therefore, is delayed 0.04 second as compared with its occurrence in the upper segment. The negative deflection continues to fall slightly and gradually until the end of systole as marked by the end of the T wave and the second heart sound, falling rapidly to the base line in early diastole with a negative deflection in the rapid inflow phase.

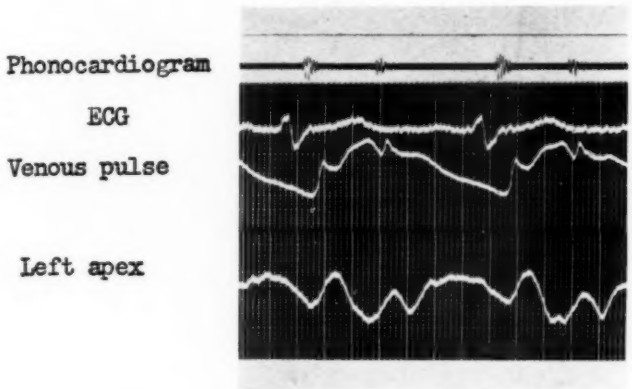


Fig. 3. Case 3. Frank systolic expansion at left ventricular apex in a case of myocardial infarction.

Case 3 is shown very briefly to illustrate frank systolic expansion which reaches a maximum before the end of the rapid ejection phase. In this case the rapid inflow phase is not paradoxical. Presumably this represents a less severe disturbance in ventricular contraction (Fig. 3).

In summarizing the findings in these three cases, it can be stated that electrokymograms of the left ventricle show a normal pattern over the upper left ventricular border. In the lower ventricle there is a delay in the beginning of contraction, which is followed by prolonged systolic mesial movement. In two of the cases there are frank systolic expansion above the apex of the left ventricle and paradoxical movement in the rapid inflow phase. With rare exceptions such findings indicate antecedent myocardial infarction or ventricular aneurysm.

HEART BLOCK

Of the various arrhythmias A-V heart block is a fruitful subject for electrokymographic study since observations can be made on the form of auricular contractions uninfluenced by ventricular movement and *vice versa*. Because other physiologic recordings are made simultaneously, many interesting correlations are possible, such as the effect of auricular contraction on the first heart sound and on ventricular filling. Two cases of complete A-V dissociation with slow ventricular rate were chosen for this presentation.

Form of Auricular Kymogram: In both cases, (Figs. 4 and 5) kymograms obtained from the left auricular appendage and the right cardiac border presented pure auricular movements uninfluenced by significant movement of the adjacent ventricles. The auricular systole in both cases is represented by a downward (mesial) movement beginning 0.10 second after the onset of the P wave. It reaches its greatest depth in the next 0.14 second and then returns toward its precontraction level. In both cases of heart block, auricular movements begin simultaneously over the right and left auricular regions, indicating simultaneous activation and contraction of the two auricles. There is no detectable dif-

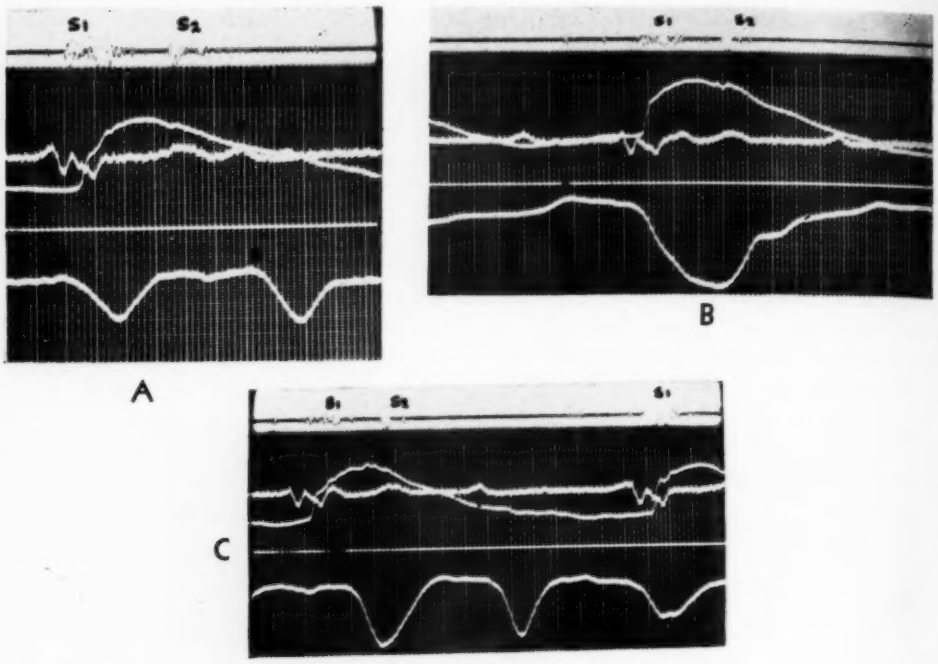


Fig. 4. A-V heart block: Case 1. Electrokymogram recorded with phonocardiogram, ECG, and carotid pulse. A. Right cardiac border. B. Upper left ventricle. C. Right border.

ference in the form of contraction wave of the two auricles.

In Case 2 there is a striking variation in amplitude of the auricular systolic wave depending upon its position in relation to ventricular systole (Fig. 5A). When auricular systole begins in late systole of the ventricles and the P wave in the electrocardiogram is simultaneous with the T wave, the auricular contraction is of large amplitude. When the auricular systole begins in mid-diastole of the ventricles, the auricular wave is of medium size. When the auricular systole begins in late diastole of the ventricles and the P wave just precedes the QRS, the auricular wave is smallest in size.

Analysis of the venous pulse in this case demonstrates a similar but less marked variation in the size of the "*a*" wave, the large auricular pulsation in late systole being associated with a tall "*a*" wave and the smaller auricular wave in late diastole with a smaller "*a*" wave. No consistent variation in the intensity of the auricular sound could be detected in the phonocardiogram.

In Case 1 (Fig. 4C) a similar progressive diminution in the size of the auricular pulsation may be observed as its position shifts from late ventricular systole to late diastole, but the effect is less striking because the position of the auricular waves relative to the ventricular waves is not constant as it is in Case 2.

These observations point to a distinct relation between the amplitude of auricular contraction and the phase of systole or diastole of the ventricles, the largest auricular movements occurring in late systole, when the ventricles are empty but under high tension and the A-V valves are closed. The smallest occur in late diastole, when the ventricles are filled. These findings are apparently contrary to reports in the literature (10, 11) concerning the output of the auricle when auricular contraction occurs in various phases of ventricular

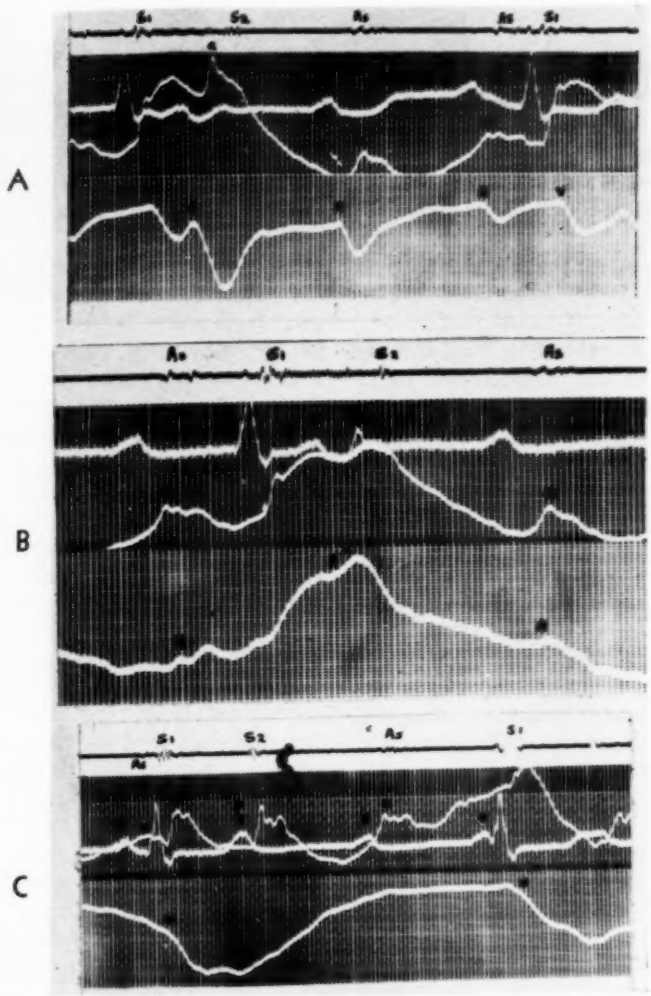


Fig. 5. A-V heart block: Case 2. Electrokymogram recorded with phonocardiogram, ECG, and jugular venous pulse. A. Right cardiac border. B. Aorta. C. Mid left ventricle.

systole and diastole. This has been judged by the effect on ventricular filling. The early experiments of Gesell (10) indicated that auricular contraction occurring during ventricular systole had no effect on increasing ventricular output, whereas auricular contraction completed in last diastole of the ventricles had the greatest effect. Wolferth and Margolies (11) reported also an increase of arterial pulse amplitude when auricular systole fell in late diastole of the ventricles, which they attributed to increased ventricular filling and increased initial intraventricular tension. It therefore seems contradictory that we found the amplitude of auricular contraction smallest in late diastole and greatest in ventricular systole.

A reasonable explanation for this apparent contradiction lies in the effect of ventricular systole on auricular filling which has been demonstrated by roentgenkymography, roentgencinematography, and angiocardiography (12–14). Systole

of the ventricles is accompanied by a downward movement of the A-V valves caused by contraction of the septum. This may produce a sucking effect within the auricles which is responsible for auricular filling during ventricular systole. When an auricular systole occurs during early ventricular diastole, after the A-V valves have opened, there will be an associated fairly large contraction since the auricles are well filled and there is no hindrance to the expulsion of blood. If an auricular contraction occurs in late diastole following one which has occurred in the same ventricular diastole, the contraction will be smaller, since optimum auricular filling did not take place. In other words, there has been no ventricular contraction between the two auricular contractions to aid in auricular filling. When auricular contraction occurs during ventricular systole the auricles contract against closed A-V valves. There is a marked increase in intra-auricular pressure and perhaps, therefore, an increased auricular contraction. The larger "*a*" wave in the venous pulse would be explained by reflux into the superior and inferior venae cavae.

Transmitted Auricular Waves: An auricular contraction wave could be detected over portions of the cardiac borders distant from the left and right auricular segments. Upward (lateral) movements of the aorta are visible in the records of both cases, beginning 0.16 to 0.20 second after onset of the P waves (Fig 5B). In Case 1, small synchronous upward auricular movements are visible also in the carotid pulse curve. In Case 2, in which a jugular venous pulse curve was recorded, the auricular movements over the aorta follow the "*a*" waves in the jugular pulse by 0.04 second or 0.18 second after the onset of the P wave (Fig. 5B). The auricular pulsations over the auricular segments, on the other hand, begin only 0.10 second after onset of the P waves, indicating a delay of 0.06 to 0.08 second in transmission of the auricular wave to the great vessels. This delay would suggest that the auricular movements superimposed on the aortic curve are due to transmitted volumetric or pressure changes rather than a transmission of movement from auricle to aorta by contiguity. In favor of this explanation is the fact that the pulmonary artery, which is in almost direct contact with the left auricular segment, fails to show any evidence of auricular movement in Case 1. In Case 2 the pulmonary artery does show auricular movements, which are downward (mesial) waves beginning 0.08 second after the onset of the P waves, indicating that, unlike the movements over the aorta, they are transmitted directly from the adjacent left auricle.

Transmitted auricular movements are superimposed also on the ventricular kymographic curves: In Case 1 (Fig. 4B), slight upward (lateral) movements are visible over the upper left ventricular segment approximately 0.16 second after the onset of the P waves, similar in position to those demonstrated in the aorta, suggesting that they represent filling of the left ventricle coincident with each auricular contraction (15). In Case 2 (Fig. 5C) similar small upward movements are visible over the apical region of the left ventricle, beginning 0.10 second after the onset of the P wave and synchronous with the auricular waves recorded over the auricular regions. It is of interest that distinct auricular movements are not visible in the middle or upper left ventricular segments, which are closer to the auricular segment than the apical region. The explanation for the findings at the apex is not apparent.

Auricular Sounds: Simultaneous recording of the electrokymogram with the phonocardiogram yields interesting observations regarding the auricular sound and variations in intensity of the first heart sound in heart block. In both of our cases a distinct auricular sound of low amplitude and frequency is recorded following each auricular wave. These sounds are more distinctly recorded in Case 2, in which a low frequency microphone was employed (Fig. 5). The sounds begin on the descending limb of the auricular wave (middle of auricular systole) approximately

0.16 second after the onset of the P wave and synchronous with the "*a*" wave of the venous pulse. They end with the termination of the auricular wave.

The mechanism involved in the production of the auricular sound is not clear. It may be muscular in origin and produced by the actual auricular contraction or it may be produced by the passage of blood from the auricles into the ventricles. Our kymographic studies did not aid in clarifying this problem because the intensity of the auricular sounds seemed to be uniform and did not vary with the stage of the cardiac cycle in which they occurred or with the amplitude of auricular contraction. However, the fact that the sound does not begin simultaneously with auricular contraction suggests that muscular contraction is not an important factor in its production.

The First Heart Sound: It has long been known that in heart block a striking variation occurs in the intensity of the first heart sound, particularly a periodic accentuation of the first sound, the so-called *bruit de cannon*. The latter was attributed at first to increased ventricular filling and stronger ventricular contraction as a result of more numerous auricular systoles in the cycle preceding the loud first sound (15). A recent and more adequate explanation (11, 16) correlates these changes with the interval between the auricular and ventricular contraction, the first sound being loud when this interval is short and faint when it is prolonged beyond 0.18 second. This inverse relation between intensity of the first sound and P-R interval was attributed to the effect of auricular contraction on the position and tension of the A-V valves, the vibrations of which are thought by many to be responsible for the major part of the first sound (17).

Periodic accentuation of the first sound was audible and recorded in both of our cases of heart block (Figs. 4A and C, 5C). Our tracings confirmed the observation that the intensity of the first sound was closely related to the length of the P-R interval. A loud first sound occurred in Case 1 whenever the P-R interval was less than 0.13 second, and in Case 2 when it was less than 0.18 second. When the interval was of greater duration, the first sound became faint.

In Case 1 the following fairly constant relation was noted:

(*a*) When the P-R interval measured 0.08 to 0.09 second, the auricular contraction preceded the first sound by 0.06 to 0.08 second and the latter was accentuated in its early portion (Fig. 4C).

(*b*) When the P-R interval measured 0.03 to 0.04 second, the auricular contraction and the first sound were simultaneous and the accentuation was in the middle of the first sound, about 0.12 second after the onset of auricular contraction (Fig. 4A).

Increased intensity of the first heart sound was not accompanied by increased amplitude of ventricular contraction or of the arterial pulse, ruling out increased stroke output as the cause. Similarly, mere superimposition of the auricular sound on the first sound during simultaneous auricular and ventricular contraction is not an adequate explanation. Wiggers (18) attributed the loud first sound to the inverse relation existing between initial ventricular tension and height of intraventricular pressure, on one hand, and the interval by which auricular precedes ventricular contraction, on the other. Wolferth and Margolies (11) stressed the importance of the position of the A-V valve leaflets at the beginning of ventricular systole in determining the intensity of the first sound. A more rapid rise in intraventricular tension was believed to occur when the A-V valves were near the position of closure, thus preventing regurgitation into the auricles in the isometric phase of ventricular systole. The valve is supposed to be in the position of approaching closure soon after auricular contraction. It was reasoned, therefore, that if ventricular contraction closely follows auricular contraction, the building up of greater initial ventricular tension leads to stronger ventricular contraction and a louder first sound. On the other

hand, Dock (16) demonstrated experimentally that a vigorous ventricular systole with high ventricular tension may produce no sound. He believed that sudden tensing of the A-V valve leaflets produced the vibrations of the first sound and he attributed variations in intensity of the first sound to variations in tension of the valve leaflets at the onset of ventricular systole. Thus, when ventricular systole occurs soon after auricular contraction, *i.e.*, when the intra-auricular pressure is high and flow into the ventricles is at its peak, the A-V valves are open and the leaflets slack and pressed toward the ventricle. A loud sound then results when the ventricular systole suddenly takes the slack out of the valves.

Our tracings show that the loud first sound in heart block is not accompanied by increased amplitude of ventricular contraction or arterial pulse. It is unlikely therefore that the loud first sound is associated with increased stroke output or vigor of ventricular contraction.

In this connection the varying position of the accentuated first sound with respect to the onset of ventricular systole as the P-R interval changed was of great interest. Thus, a relatively long P-R interval of 0.07 to 0.08 second was associated with accentuation of the beginning of the first sound and a short P-R of 0.03 to 0.04 second with accentuation of the end of the sound. These findings are difficult to explain on the basis of any of the theories cited above, since they would not explain a change in the end of the sound when the early phase was not affected.

SUMMARY

The use of electrokymography in clinical diagnosis is reviewed briefly. Clinical application is illustrated by an analysis of the findings in three cases of coronary thrombosis. The physiologic potentialities are considered through an analysis of two cases of heart block.

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SUMARIO

Algunas Aplicaciones Clínicas de la Electroquimografía

Por medio de un análisis de los hallazgos en tres casos de infarto miocardíaco ilústrase la aplicación clínica de la electroquimografía. En esos tres casos los electroquimogramas del ventrículo izquierdo revelaron un patrón normal sobre el borde izquierdo superior. En la porción baja del ventrículo había demora en el comienzo de la contracción, seguida de prolongado movimiento mesosistólico. En dos de los casos había franca expansión sistólica más arriba de la punta del ventrículo izquierdo y movimiento paradójico en la fase de entrada rápida. Con raras excepciones esos hallazgos indican previo infarto miocardíaco o aneurisma ventricular.

Las potencialidades fisiológicas del procedimiento se demuestran con el estudio de dos casos de bloqueo cardíaco.

DISCUSSION

Frederick G. Gillick, M.D. (San Francisco, Calif.): Before commencing my discussion of the principal portion of Dr. Sussman's paper, I wish to make a few comments regarding the use of the electrocardiogram, heart sounds, venous pulse, and carotid artery pulse for correlation of events noted in the heart cycle. Boone and I, in 1945 and 1946, studied the relationship of the electrocardiogram to the carotid pulse when taken simultaneously. We found variations in the same individual on continuous recordings of Lead II of the magnitude of 0.03 to 0.05 second. By use of recorded heart sounds, we have found it difficult to pick uniformly the exact point of reference for the onset of the first sound. I believe this difficulty can be appreciated more readily if one will picture the recordings obtained in marked ventricular asynchronism and in certain valvular lesions. Routinely, heart sound recordings do not allow the flexibility desired in electrokymography. Under special circumstances, such as in mitral stenosis, heart sounds are very valuable and should be used. Venous pulse tracings, while they may be obtained, do not lend themselves to the type of flexibility desired for electrokymography. In our experience, the carotid pulse, while not without its difficulties, has proved thus far to be the most readily adaptable means of timing. Dr. Sussman has employed the simultaneously recorded heart sounds, carotid pulse, and electrokymogram of the heart border. This, I believe, is most satisfactory, because the heart sounds serve as a check on the carotid and further give valuable information, when the cardiac valvular system is normal, regarding the onset of isometric contraction.

During the past three years I have had the opportunity of observing many cases with the type of paradoxical motion of the ventricle which Dr. Sussman describes. This paradoxical motion of the left ventricle has practically always been ascribed by the roentgenkymographers to myocardial infarction. Since I have observed this type of abnormality of left ventricular motion in patients with neither an electrocardiogram nor a clinical history indicative of myocardial infarction, and further, since I have noted this same type of motion in the right ventricle in at least twenty-five individuals, I am very hesitant to ascribe the cause of paradoxical ventricular motion to myocardial infarction *per se*. Rather, I believe that myocardial infarction is merely one of the causes; perhaps, as autopsy reports become available and further experimental research is done, we will find that diffuse myocardial fibrosis, local and general myocarditis, ischemia, and certain biochemical abnormalities can also produce this effect.

Dr. Sussman has pointed out what I believe to be a very important observation—namely, a prolonged lateral motion in early systolic ejection of more than 0.04 second before medial motion takes place. It has been my observation that lateral motion during the initial period of systolic ejection normally is 0.06 second or less and thus far, in all cases where it was 0.08 second or greater, the correlation with other gross electrokymographic, electrocardiographic, and/or clinical history abnormalities has been practically 100 per cent. The explanation of this delay in medial motion during systolic ejection is not entirely clear. Dr. Sussman, however, has supplied a clue, namely, medial motion begins when the load in the ventricle has been reduced. The explanation I have offered in an article recently submitted for publication was to the effect that the ventricular septal musculature initiates systolic ejection, thus pulling the A-V ring towards the apex, which results in an early bulging of the walls, before the musculature of the walls can effectively contract against the load in the ventricle. The logic of early lateral motion of the ventricular wall up to 0.06 second can readily be realized when one notes that the difference

in electrical activation of the upper portion of the septum and the upper portion of the left ventricle is in the order of 0.055 to 0.065 second.

The observations of auricular activity during heart block are well made and certainly blaze a trail toward further understanding of some of the clinical phenomena reported concerning auricular and first heart sounds.

The field of electrokymography, while relatively simple in technic, requires for its interpretation considerable understanding of the physiology of the dynamics of the systemic and pulmonic cardiovascular systems. The clinical as well as the physiological significance of the report just presented will become fully realized only if we approach the subject fully armed with the fundamental principles of hemodynamics. Dr. Sussman and his co-workers are to be congratulated on their study and more especially on their careful approach and analysis of the material presented.

Angiocardiographic Interpretation[1]

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ANGIOCARDIOGRAPHY, since its introduction in 1938 by Robb and Steinberg, has been widely employed in the study of the heart and thoracic blood vessels. To fill a definite need for data on the normal angiocardiographic findings, a series of idealized diagrams has been prepared. The drawings represent the study of many hundreds of angiocardiograms and are not tracings of actual contrast films. These diagrams may be referred to as a guide in interpreting conventional roentgenoscopic and roentgenographic as well as angiocardiographic studies of the heart, and will be of particular value to the radiologist who anticipates only the occasional use of angiocardiography. Detailed descriptions of angiocardiographic technic and interpretation are referred to in the appended selected bibliography.

It is to be emphasized that, while modern rapid film changers have increased the angiocardiographic yield, they have largely served to supplement the method as originally described. With a standard stereo-cassette changer, satisfactory diagnostic examination can readily be accomplished, thus bringing the procedure well within the scope of the small hospital or the average radiologist.

Generally, a given angiocardiographic film cannot be expected to reveal all of the structures of either side of the heart as they are represented in the following figures. Variation from patient to patient and with the exposure time naturally occurs. Right and left heart filling is shown in each of the four standard chest projections (Figs. 1–4).

Frontal Projection: This is the position of choice for the delineation of lung tumors, hilar and mediastinal structures, interatrial defects, pulmonary circulation, and venous drainage into the right heart. Normally, right heart opacification occurs at between one and three seconds following the beginning of the injection, while the left heart and aorta are opacified at seven to eleven seconds. These figures vary between individuals and are of course greatly altered by abnormal circulatory dynamics. In the frontal projection, neither the left atrium nor the right ventricle is normally border-forming. The pulmonary artery and its left main branch rather than the pulmonary conus comprise the midportion of the left heart border.

Left Anterior Oblique Projection: This is the position of choice for study of the aorta, the ventricles, and the majority of congenital anomalies. It is of particular value in the measurement of the mid ascending aorta (as in syphilitic aortitis), and best demonstrates the abnormality in coarctation of the aorta and patent ductus arteriosus. The left anterior oblique projection affords an open view of the aorta and an end-on view of the septum. The four cardiac chambers are maximally separated in this projection. The pulmonary conus forms a portion of the anterior cardiac margin in both oblique projections. Oblique views in angiocardiography are usually extreme obliques, more closely approaching the lateral projection than is customary.

Lateral Projection: This projection is especially valuable in the profile delineation of the right ventricular outflow tract and the mainstem pulmonary artery, and is the projection of choice for the demonstration of uncomplicated pulmonic stenosis in the adult. It should be recognized that the angiocardiographic configuration of the pulmonic conus varies significantly with the phase of cardiac contraction. Be-

[1] From the Department of Radiology of the New York Hospital, Cornell Medical Center, New York, N. Y. This investigation was aided by a grant from the Schering Corporation. Accepted for publication in October 1948.

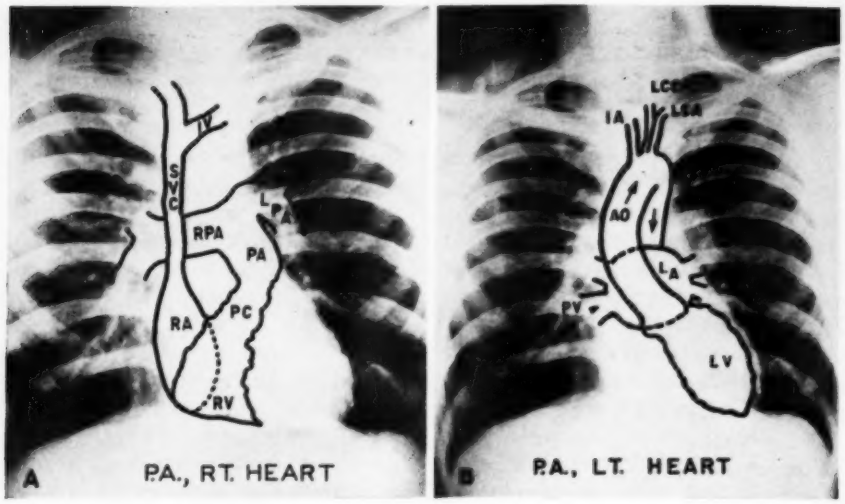

Fig. 1. A. *Frontal projection, right heart.* Idealized diagram of angiocardiographic configuration. IV. Left innominate vein. SVC. Superior vena cava. RA. Right atrium. RV. Right ventricle. PC. Pulmonary conus. PA. Pulmonary artery. LPA. Left pulmonary artery. RPA. Right pulmonary artery.

B. *Frontal projection, left heart.* IA. Innominate artery. LCCA. Left common carotid artery. LSA. Left subclavian artery. PV. Pulmonary veins. LA. Left atrium. LV. Left ventricle. AO. Aorta.

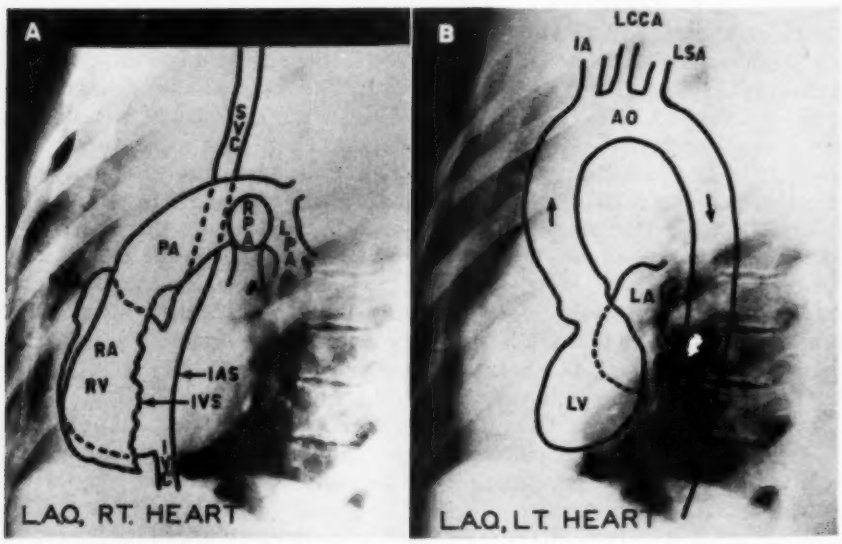

Fig. 2. A. *Left anterior oblique projection, right heart.* SVC. Superior vena cava. IVC. Inferior vena cava. RA. Right atrium. RV. Right ventricle. RAA. Right auricular appendage. PA. Pulmonary artery. RPA. Right pulmonary artery. LPA. Left pulmonary artery. IAS. Interatrial septum. IVS. Interventricular septum.

B. *Left anterior oblique projection, left heart.* IA. Innominate artery. LCCA. Left common carotid artery. LSA. Left subclavian artery. LA. Left atrium. LV. Left ventricle. AO. Aorta.

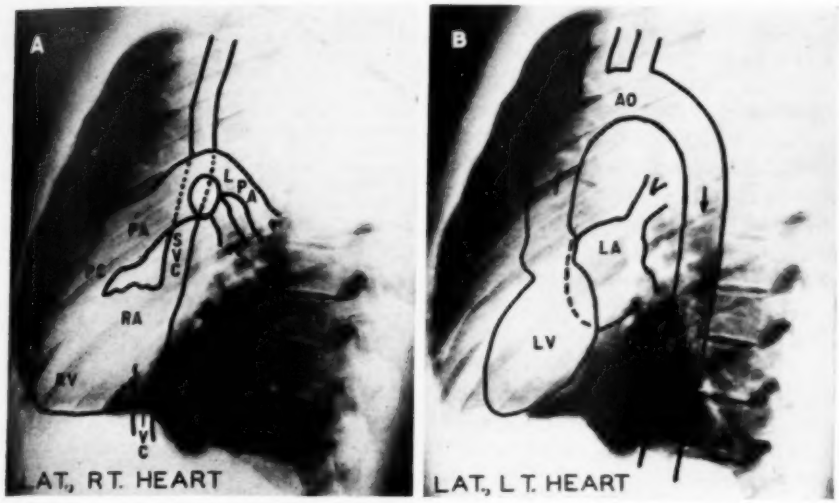

Fig. 3. A. *Lateral projection, right heart.* SVC. Superior vena cava. IVC. Inferior vena cava. RA. Right atrium. RV. Right ventricle. PC. Pulmonary conus. PA. Pulmonary artery. LPA. Left pulmonary artery. The circular midhilar shadow represents the end-on view of the right pulmonary artery.

B. *Lateral projection, left heart.* LA. Left atrium. LV. Left ventricle. AO. Aorta. Note the bulges of the sinuses of Valsalva just above the origin of the aorta.

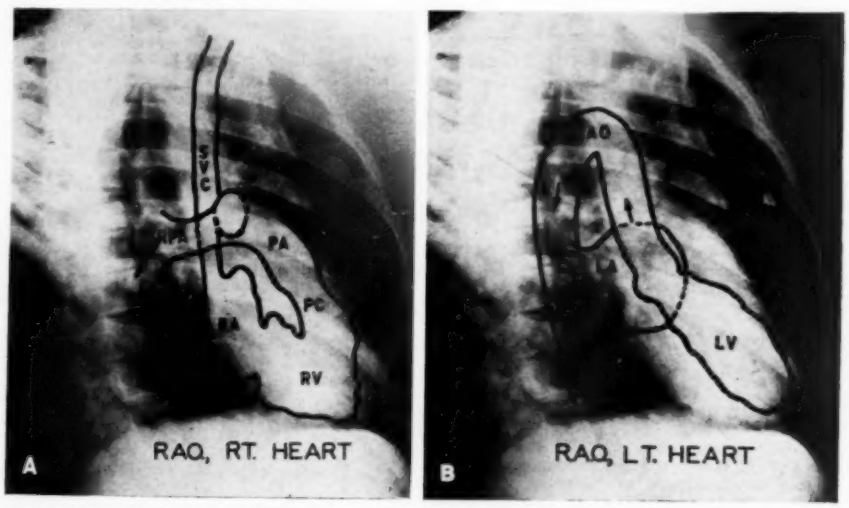

Fig. 4. A. *Right anterior oblique projection, right heart.* SVC. Superior vena cava. RA. Right atrium. RV. Right ventricle. PC. Pulmonary conus. PA. Pulmonary artery. RPA. Right pulmonary artery. The left pulmonary artery is seen as a rounded, double-density midhilar shadow.

B. *Right anterior oblique projection, left heart.* LA. Left atrium. LV. Left ventricle. AO. Aorta. In this projection, the left atrium and the right atrium form the posterior cardiac border.

cause of its greater distance from the film and the consequent distortion, the aorta should not be measured in this projection.

Right Anterior Oblique Projection: This projection is included for academic purposes and for the sake of completeness. It

is rarely employed in routine angiocardiography except for the detection of early mitral stenosis. In this projection, both atria form a portion of the posterior cardiac shadow, the left atrium lying above the right atrium. The projection is of value in detecting enlargement of the inflow tract of the right ventricle, and is occasionally of use in the exact localization of mediastinal tumors or intrathoracic foreign bodies.

CONCLUSIONS

1. The angiocardiographic appearance of the normal heart has been illustrated by means of idealized diagrams made after a study of over 600 angiocardiographic visualizations.
2. A selected bibliography is appended.

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SUMARIO

Interpretación Angiocardiográfica

El aspecto angiocardiográfico del corazón normal aparece aquí ilustrado por medio de diagramas idealizados ejecutados tras el estudio de más de 600 visualizaciones angiocardiográficas.

En la proyección frontal, ni la aurícula izquierda ni el ventrículo derecho forman normalmente borde. La arteria pulmonar y su principal rama izquierda comprenden la porción media del borde izquierdo del corazón.

La proyección oblicua anterior izquierda facilita una vista abierta de la aorta y una vista de punta del tabique. El cono pulmonar forma una porción del borde cardíaco anterior en esta proyección así como en la oblicua anterior derecha.

La proyección lateral es sobre todo valiosa en la delineación en perfil del trayecto de salida del ventrículo derecho y del tronco principal de la arteria pulmonar. No debe medirse la aorta en esta proyección.

La proyección oblicua anterior derecha sólo se emplea de cuando en cuando. En esta vista ambas aurículas forman parte de la imagen cardíaca posterior, quedando la izquierda sobre la derecha.

Experimental Chemotherapy of Neoplastic Diseases[1]

MICHAEL B. SHIMKIN, M.D., and HOWARD R. BIERMAN, M.D.

IT IS INTRIGUING to forecast the advances in cancer research that may be anticipated during the forthcoming decade. The exploration, by trained investigators with imagination, of such new fields as intermediary metabolism with the aid of radioactive and heavy isotopes, cytochemistry in conjunction with tissue culture, the isolation and identification of nucleoproteins and other components of cells, and the measurement of biologic phenomena by sensitive electronic methods, will extend biologic research, including the study of cancer, beyond horizons which now can be envisioned.

It is logical to anticipate that the eventual solution of the cancer problem will be achieved through fundamental investigations of carcinogenesis and of the nature of the cancer cell. Several large programs of research, however, are being devoted to a systematic examination of numerous chemical agents for their effect on neoplastic growth. This semi-empirical approach has already yielded a number of compounds having some action on certain types of neoplasms and may well unearth drugs effective against cancer before the nature of the disease is clarified through fundamental studies.

Most important to cancer research has been the recent great expansion of financial support for additional facilities and training of research personnel. Under the leadership of the United States Public Health Service and of the American Cancer Society, funds available for cancer research in the United States have increased from something like one million dollars per year before the war to over twenty million annually during the past two years. While it is true, of course, that results in research cannot simply be bought, the essential ingredients for expanded, accelerated investigations are being provided. It is now possible to plan long-term research of fundamental significance. It is also possible to close the wide gap that has existed between laboratory findings and their clinical trial and application.

Several outstanding reviews (1–3) recently have indicated the difficulties that are faced by an investigator in search of effective agents against cancer. In a theoretical discussion, it can be postulated that such agents must either selectively destroy neoplastic growth or cause its regression without serious injury to normal tissues, or selectively interfere with some vital nutritional, vascular, or other environmental requirement of neoplastic growth without seriously impairing similar needs of normal tissue. Conversely, agents can be imagined which would enhance the resistance of tissues or the body to the continued proliferation and destructive effects of cancer. These broad generalizations, however, do not suggest specific lines of experimentation. The investigator is still confronted with the testing of agents for their effect on tumor growth on a more or less empirical basis, or on the bias of his particular interests.

The systematic testing of a wide range of compounds for their effect on tumor growth is made more difficult by the absence of a really adequate test subject or method. Numerous technics of screening and of further testing of such compounds have been suggested and are being used by different laboratories (3).

A positive effect of a given chemical on animal tumors implies no assurance that a similar effect can be anticipated in man. An important consideration of such testing procedures is that some chemical that may

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have activity in man may be discarded as negative on the basis of animal experiments. In spite of these difficulties, we believe that the pressing need for an effective agent against cancer fully justifies early human experimentation with any chemical which has been demonstrated to affect animal tumors, and which has been shown by adequate pharmacologic evaluation to be of reasonably low toxicity. The important role of accentuated clinical research in cancer is impressively demonstrated by the fact that half of the eight chemotherapeutic agents now known to have some influence on certain neoplastic diseases in man were introduced on the basis of clinical observations and not as a result of animal or other laboratory studies on cancer.

Cancer research thus far has failed to yield chemical agents which are curative in neoplastic diseases. Cure at present remains with surgery and radiation therapy. Several chemical agents, such as the amine mustards, androgens, estrogens, and urethane, however, have shown marked effects of a temporary nature in specific types of neoplastic disease. The effects are too definite to be designated as merely palliative, and we (4) suggest that agents and procedures for cancer therapy be divided into three general classes: (*a*) curative agents or procedures, which completely remove the neoplastic process; (*b*) arresting agents, which significantly and objectively alter the nature of the neoplasm or the course of the neoplastic disease, with temporary remission of the symptoms and signs due to the neoplastic process; (*c*) palliative agents or procedures, which influence neither the neoplasm nor the course of the neoplastic process but alleviate some of the symptoms of the disease.

Surgery and radiation therapy also remain as the chief methods for temporary arrest of the disease or for palliation. At the present time, approximately 50 per cent of the patients with cancer are treated primarily by surgery, and in the other 50 per cent radiation is the primary treatment.

The results achieved and recorded with testosterone and estrogens in carcinoma of the breast, with the amine mustards and urethane in leukemia and Hodgkin's disease, and with stilbamidine in multiple myeloma, in most instances can be equalled or bettered by the proper use of radiation therapy. The only exceptions to this are the results in prostatic carcinoma with castration or estrogens.

The treatment of neoplastic disease by radioactive substances so far available represents another method of administering ionizing radiation, either in the form of total body irradiation, as with radioactive phosphorus or sodium, or with some degree of selectivity, as with radioactive iodine (5, 6). For this reason, discussion of radioactive substances is not included in this summary.

POTASSIUM ARSENITE IN LEUKEMIA

Perhaps the oldest chemotherapeutic agent for neoplastic disease still retained in clinical practice is potassium arsenite in the management of myelocytic leukemia. Introduced in 1865, its use was re-emphasized by Forkner (7, 8). The chemical is administered orally as Fowler's solution (1 per cent solution of potassium arsenite), starting with 0.3 c.c. three times a day, and increasing the dose by 0.1 c.c. until 0.6 c.c. is being given three times a day. The dose is then progressively decreased to the original 0.3 c.c. three times a day and maintained at that level for protracted periods.

In chronic myelocytic leukemia there is usually a progressive drop in the white blood cell count with disappearance of immature elements from the peripheral blood within two or three weeks. The spleen decreases in size and the clinical condition of the patient improves.

The untoward effects of this therapy are occasional loss of appetite, nausea, diarrhea, and scaliness of the skin. As with any other therapy which depresses the bone marrow, the patient has to be watched carefully for possible damage to the hematopoietic system. It is of interest that

arsenic has been shown to have carcinogenic properties in man (9).

It is surprising that the basis of much reference to arsenic in the treatment of myelocytic leukemia is a 1931 report of 10 cases by Forkner and Scott (8) with a short follow-up of the patients. No larger series nor any showing the end-results of the therapy are available in the literature. It may be presumed, however, that potassium arsenite has temporary arresting effects upon chronic myelocytic leukemia. There is no evidence that the life-span is prolonged.

Occasional favorable responses are also observed in chronic lymphocytic leukemia and some non-leukemic lymphomas. It would be of value if the results of treatment with potassium arsenite, on a larger number of patients and with longer follow-up, could be assembled and evaluated.

URETHANE IN LEUKEMIA

The use of urethane (ethyl carbamate) in myelocytic and other leukemias in man has an interesting historical background. It was introduced clinically by the London group (2, 10) because it was found to have some inhibitory action upon the growth of the Walker rat carcinoma. The results in human carcinoma were negative, but it was noticed that urethane produced a fall in leukocytes in some patients, and its trial was extended to leukemia.

The accumulated evidence to date (10–14) indicates that urethane has a place in the adjunctive treatment and management of chronic myelocytic leukemia. The recommended administration is by the oral route, 1.0 gm. three times a day in the form of enteric-coated capsules, until an effect is noted upon the blood picture. Nausea, and occasionally vomiting, is encountered during the administration of the drug but is seldom of sufficient severity to interrupt therapy, although reduction of dose is sometimes necessary. Within two to four weeks there is usually a marked drop of the white count in myelocytic leukemia and other evidences of clinical remission, such as reduction in the size of the spleen and liver, a rise in red blood cell count and hemoglobin, and improvement in the general condition of the patient. There is insufficient indication that urethane therapy in chronic myelocytic leukemia should be continuous.

Of 57 cases of chronic myelocytic leukemia gathered from five series (10–14), excluding those in terminal condition, a satisfactory response was achieved in 49. In chronic lymphocytic leukemia, 21 of 43 patients responded satisfactorily to urethane therapy.

Urethane therapy has no effect in Hodgkin's disease or lymphosarcoma, or in other types of neoplastic disease. One of two patients with multiple myeloma reported by Alwall (15) apparently responded to urethane with the disappearance of myeloma cells, reversal of abnormal blood changes, and improvement which lasted for eight months. However, another case was not affected by this therapy, and the case of Wilson *et al.* (14) and one of our cases treated in the same manner showed no effect. Urethane has proved of no value in the treatment of acute leukemia.

Urethane is a bone-marrow depressant, and the untoward reactions of leukopenia, thrombocytopenia, anemia, and hemorrhagic tendencies can be expected in some cases with hematologic disorders. Careful observations of the patient receiving this therapy are obviously indicated. Deaths which may be attributed to urethane have been reported (16).

It is of interest that in mice and rats injected with urethane pulmonary tumors develop (17). No data are available to date to indicate that this carcinogenic effect may be anticipated in man.

It is considered that urethane is a definite adjunct in the management of myelocytic leukemia but has demonstrated no particular advantage over arsenic therapy. It is probably less dependable in the management of the leukemias than roentgen irradiation. There is no evidence that urethane has any effect upon the life-span of individuals with myelocytic or lymphocytic leukemia.

AMINE MUSTARDS IN LYMPHOMAS

The amine mustards (methyl-bis or tris (beta-chloroethyl) amine) have been in clinical use for approximately five years (18). Records of their employment in over a thousand patients with neoplastic disease have appeared in the literature (18–29). They have definite arresting and palliative effects in some lymphomas, particularly Hodgkin's disease, and occasionally in some other neoplastic diseases.

Methyl-bis or methyl-tris (beta-chloroethyl) amine hydrochloride, commonly referred to as HN2 or HN3, is usually administered intravenously in four to six daily doses of 0.1 mg. per kilogram of body weight. The drugs are best injected into the rubber tubing of a rapidly running intravenous infusion of saline, flushing the vein thoroughly to avoid the frequent complication of thrombophlebitis. We (25) have used a heavier dose schedule, up to 0.6 mg. per kilogram of body weight in one single dose. This is not recommended except in patients who have not responded to a previous dose of 0.3 mg. per kilogram.

The amine mustards produce severe toxic reactions and serious complications, particularly in patients who are in poor clinical condition in regard to their hematologic status. The acute reactions to the agents are nausea and vomiting, sometimes lasting for several days; mild diarrhea occurs in most patients receiving larger amounts of the drug. Unsustained horizontal nystagmus, frontal headache, and occasional drowsiness may be experienced by some patients. These effects, although unpleasant, have resulted in no serious complications. Within two weeks after therapy, and in direct relation to the total dose given, there is a considerable drop in the white blood cell count in the bone marrow as well as in the peripheral blood. The leukopenia is more marked in patients with neoplastic disease involving the hematopoietic system than in those with other forms of cancer. The white blood count spontaneously returns to normal within three or four weeks, and the leukopenia itself has not been a serious problem. Of great consequence, however, are the occasional severe depressive effects on the platelets, red blood cell elements, and the coagulation mechanism. In our series of 67 cases treated with large doses, 3 terminated fatally, with clinical manifestations of a hemorrhagic diathesis associated with thrombocytopenia and prolonged bleeding and clotting time.

It has been reported (30) that toluidine blue given intravenously in doses of 1 to 2 mg. per kilogram of body weight is of assistance in the treatment of these hemorrhagic diatheses, and we have found it useful in some but not all cases. Depending upon the hematologic status of the patient, amine mustard therapy can be repeated at intervals of six to eight weeks. Cumulative effects have not been observed after as many as ten repeated courses at one to two month intervals.

Immediately after HN2 therapy, patients go into sharp negative balance in nitrogen, sodium, and potassium, indicating endogenous cellular destruction but not implying any specific action on neoplastic tissue in contrast to effects on normal tissues (31). We have been unable to detect any effects of HN2 upon the liver or kidney function, or the cardiovascular system.

A summary of 7 series (19–25), including over 200 cases of Hodgkin's disease treated with amine mustards, indicates that a remission of the disease can be expected in over 90 per cent of patients who are in good physical condition and who have not been treated with roentgen rays. About 70 per cent of patients who have been treated with roentgen rays and who are still responding favorably to such therapy at the time the amine mustards are administered show good response to these preparations. Only 50 per cent of the patients who have had their disease for three years or more, who are no longer responding to roentgen therapy, and who are in poor physical condition, respond to amine mustard therapy.

The arresting action of amine mustards in Hodgkin's disease is manifested by a

prompt regression of fever, adenopathy, splenomegaly, and hepatomegaly, a gain in weight, remission of constitutional symptoms, and a return to a sense of well-being. The average remission period following therapy, however, is only about three months in length, although remissions for over a year have been observed in individual cases. There is no evidence that the amine mustards significantly prolong the life-span of patients with Hodgkin's disease, although their effective and comfortable life is prolonged.

The arresting effects of amine mustards are also observed in other lymphomas and in chronic myelocytic and lymphocytic leukemia, and in erythremia. The remissions in lymphosarcoma are usually of shorter duration than in Hodgkin's disease; even in patients in fairly good general condition, the average remission is between one and two months in length, although individual cases may obtain a favorable response for over a year. In terminal patients, dramatic disappearance of lymph nodes and subcutaneous masses may be procured, but the remission lasts for a matter of days only, and the patients succumb to their disease.

The results in generalized mycosis fungoides (26–27) have been encouraging in that complete disappearance or considerable regression of the skin lesions has followed treatment in most cases, with disappearance of pruritus and improvement in general condition. The usual remission is approximately two months in length, with gradually diminishing response to repeated courses, and an eventual fatal termination. It has been reported (29) that HN2 may be of value in the treatment of sarcoidosis. We have treated two cases, with but minimal objective effects during the four months of observation. Occasional favorable responses are seen in Ewing's sarcoma, medulloblastoma, and embryonal carcinoma of the testis; in the more common types of carcinoma, no objective evidence of favorable effect on the patient or destructive effect on the tumor has been observed.

The amine mustards represent a definite addition to the armamentarium of a physician treating Hodgkin's disease or lymphosarcoma. It is our opinion that patients with lymphoma which appears clinically to be limited to one site should be treated by radical surgery followed by roentgen therapy. In cases of localized disease beyond surgical extirpation, roentgen therapy is definitely to be preferred. In generalized disease, and in cases not responding favorably to irradiation, the amine mustards should be used. In generalized mycosis fungoides, the amine mustards appear to have a definite advantage over roentgen therapy. Wintrobe and his group (20) have also managed myelocytic and lymphocytic leukemia with the amine mustards.

BACILLUS PRODIGIOSUS POLYSACCHARIDE IN LYMPHOMA AND SARCOMA

Spontaneous regression of malignant neoplastic disease in man is a rare event, and it is intriguing that in the few cases which can be even tentatively accepted the regression is usually associated with severe streptococcal infection (32). It is on this basis that Coley's mixed toxins were used some fifty years ago, with occasional favorable results (33). About four years ago, Shear and his group (34) isolated an active material from cultures of *Bacillus prodigiosus* (*Serratia marcescens*) which produced hemorrhagic effects in mouse tumors. This material has also been used clinically, and reports on some 20 cases appear in the literature (34, 35). The agent produces a high fever, leukocytosis, and a severe drop in blood pressure. Occasional decrease in the size of sarcomatous or lymphomatous tumors and clinical improvement have been observed, but the treatment is hazardous and seemingly unreliable.

We have had no clinical experience with the preparation, and the results to date do not encourage us to add to the observations. The material is of interest in that its effect seems to be primarily on the vulnerable vascular supply of the tumors.

STILBAMIDINE IN MULTIPLE MYELOMA

Stilbamidine (4,4′ - diamidinostilbene) therapy of multiple myeloma was introduced by Snapper (36, 37) because the hyperglobulinemia resembled a similar finding in cases of kala azar, in which this drug has been found to be of value. The drug is dissolved in water and is injected intramuscularly or intravenously in dosage of 50 to 150 mg., starting with a first injection of 50 mg. and increasing to 150 mg. every other day for courses of 15 to 30 administrations. The intramuscular route is probably preferable because with intravenous administration there are signs of peripheral vascular collapse and transient electrocardiographic patterns indicative of myocardial ischemia (31*a*). A late, untoward reaction of the drug is the development of a trigeminal neuropathy, which appears as early as a month after the initiation of therapy. The symptoms subside slowly, but dissociated anesthesia persists for a long time. Snapper states that continuation of stilbamidine does not seem to aggravate these symptoms. One interesting finding is the appearance of basophilic inclusion bodies in the myeloma cells following stilbamidine therapy (38).

Karnofsky (3) summarized the results in 186 cases of multiple myeloma treated with stilbamidine. Twenty-five per cent of the patients had complete relief of the pain and another 38 per cent had partial relief. In 30 patients the facial neuropathy mentioned above developed. Less than 5 per cent of those treated showed objective signs of improvement of the bone lesions on x-ray examination. We (31) have treated 6 cases of multiple myeloma with stilbamidine. In all 6 there was marked alleviation or complete disappearance of bone pain shortly after the initiation of the therapy. In no case has there been objective evidence of improvement of the disease. In 1 patient facial neuropathy developed. We believe that stilbamidine, at present, has a definite place in the management of cases of multiple myeloma, but its effects appear to be chiefly palliative in nature. It is ineffective in other forms of lymphoma or neoplastic disease.

PTEROYLGLUTAMIC DERIVATIVES IN ACUTE LEUKEMIA

A number of pteroylglutamic conjugates, particularly pteroyltriglutamic acid ("teropterin") were tested clinically in 90 cases of neoplastic disease by Farber and his group (39). Another report (40) added 20 more cases, but neither revealed any impressive evidence of objective effects. It is interesting that this work was based on reports that folic acid administration produced regressions of mammary tumors in mice of one colony, a finding which was not confirmed in several other laboratories. We (31) have administered teropterin and the diglutamic conjugate ("diopterin") to 7 patients with neoplastic disease, and to another 9 in conjunction with HN2 (25). In none was there evidence of objective effect of any kind. As has been stated by Farber (39), a sense of temporary well-being and other subjective improvement are occasionally observed, which we attribute to the psychotherapeutic consequences of additional attention and the slim hope of a miracle on the part of a patient who realizes the fatal prognosis of the disease.

Recent observations (41) on the effect of a folic acid antagonist, 4-aminopteroylglutamic acid ("aminopterin"), on acute leukemias in children seem more promising. In 10 of 16 patients injected with 0.5 to 1.0 mg. of the compound daily for one week, an apparent remission of the disease was reported, manifested by decrease in the size of the spleen and liver, return of the white cells in the peripheral blood and bone marrow toward normal, and other clinical improvement. The effects obviously are not curative, and it is of interest that at least 1 of the 5 cases reported in detail had had a spontaneous remission of two months duration before therapy. Our own experience is limited to 6 cases, in 2 of which apparent remission of the acute phase of the disease was obtained. More and longer observations are necessary before

this agent can be considered of clinical value, especially since its toxicity is high.

CASTRATION AND ESTROGENS IN PROSTATIC CARCINOMA

The most striking results in disseminated carcinoma are obtained with castration or estrogenation in patients with cancer of the prostate. The classic work of Huggins and his co-workers (42, 43) has now been extended to observations of five-year results. Of 20 patients with disseminated prostatic cancer treated by orchiectomy, 18 showed a favorable response; five years later, 4 had no clinical signs of malignancy and 1 was alive with a slowly advancing lesion. Thus, a 20 per cent arrest rate of five years or longer has been achieved in a group of otherwise hopeless patients. The untoward effects are chiefly the psychic trauma incident to castration and the post-castration flushes, which can be controlled by administration of estrogens.

Results similar to those by castration are produced by estrogen therapy, although these are not as clearly documented as the series of Huggins. Of 200 cases of prostatic carcinoma treated with diethylstilbestrol at the Brady Urological Institute (44), 75 per cent showed regression of the primary growth and 45 per cent regression of metastases. The average survival in these cases was also definitely increased, to about four years, as compared with the previous average survival of approximately eight months (44–46).

It is now apparent that heavy estrogen dosage is not required, nor is it desirable, in the treatment of advanced carcinoma of the prostate. An initial dose of 5 mg. per day of diethylstilbestrol, until an effect on the breasts is evinced by enlargement and tenderness of the nipples, and a maintenance dose of 1 to 2 mg. per day appear adequate. No additional benefits are derived from larger dosage. Other estrogenic compounds, such as ethinyl estradiol in daily doses of 0.1 to 0.5 mg., may be used with equal efficacy. We (47) found it convenient to administer diethylstilbestrol in the form of subcutaneously implanted pellets of 25 mg., this dose being sufficient to produce continual effects for three months.

In our opinion, castration is the treatment of choice for disseminated prostatic carcinoma until a five-year series of patients treated with estrogens alone can show results equal to those reported by Huggins. The addition of estrogenic therapy is indicated if the benefits of castration are no longer apparent or the disease progresses despite the orchiectomy. Estrogen therapy is also indicated in localized prostatic carcinoma before surgery; Colston and Brendler (44) report 7 cases in whom preoperative estrogenation reduced the size of the local lesion so that radical resection became feasible

One of the occasional untoward effects which may be expected with estrogen therapy is due to carcinogenic activity of this group of chemicals. Abramson and Warshawsky (48) report the development of bilateral carcinoma of the breast in a 51-year-old man who ingested 1,097 mg. of diethylstilbestrol during a course of nineteen months.

ESTROGENS AND ANDROGENS IN MAMMARY CARCINOMA

The recent interest in the occasional temporary arrests of widespread mammary carcinoma by interference with the hormonal status of the host is a recrudescence of an old idea. In 1905, Lett (49) analyzed 99 cases of inoperable carcinoma of the breast treated by oöphorectomy and reported temporary improvement in 23 per cent of the cases, particularly in women under fifty years of age. This improvement was not reflected in mortality rates or length of survival. In the present vogue for this therapy, it is often forgotten that roentgen therapy accomplishes similar results, and that 15 per cent of patients with untreated carcinoma of the breast will survive for five years or longer after the onset of the disease.

The availability of a large number of chemicals with estrogenic and androgenic

properties has led to their clinical application in disseminated mammary carcinoma. Testosterone propionate, injected intramuscularly three times a week for ten weeks in 100 mg. doses, and followed by oral methyl testosterone in doses of 60 mg. per day, is recommended (50, 51) in premenopausal women. It is particularly indicated in the presence of osseous metastases, where subjective improvement is achieved in about 50 per cent and objective evidence of regression and recalcification is noted in about 25 per cent of the patients. Improvement becomes evident within three weeks, and usually lasts for two to six months. The untoward effects are masculinization, amenorrhea, and increased libido; it is stated (51) that patients with high blood calcium should be watched with particular care, as it may rise to dangerous levels with testosterone therapy.

Estrogens, usually in the form of diethylstilbestrol given orally in doses of 5 to 20 mg. per day, have definite arresting effects in approximately 40 per cent of the older (over fifty or sixty years of age), post-menopausal women with inoperable carcinoma of the breast (51, 52). The particular indication for the use of estrogens is the presence of soft-tissue metastases, which may regress along with the primary growth for periods of three to six months. The early untoward effects of the treatment are limited to nausea, occasional vomiting, and diarrhea, which often subside without reduction of the dose of diethylstilbestrol. Later complications include uterine bleeding and retention of fluids. This therapy is not indicated in younger women, in whom there is a suggestion that estrogens may accelerate the growth of the neoplasm.

In disseminated carcinoma of the breast in the male, orchiectomy or estrogen therapy sometimes results in striking temporary improvement (53).

That both androgens and estrogens have a regressive influence upon mammary carcinoma, and that oöphorectomy in women and orchiectomy in men also have occasional beneficial effects are not as enigmatic as may first appear. The tumors that are influenced by alteration of the hormonal status of the host are the better differentiated neoplasms that retain some dependence upon the hormonal substrate regulating the normal tissues of origin. A sharp alteration in the hormonal substrate, perhaps through the intermediation of the hypophysis, results in a temporary period of regression as the neoplasm adjusts itself to the new environment. There is no evidence, as with reports on oöphorectomy forty years ago, that either type of hormonal therapy has any effect on the length of survival of these patients.

In our opinion, roentgen therapy to localized bony or soft-tissue metastases of carcinoma of the breast remains the treatment of choice (54). Androgen and estrogen therapy may be a valuable adjunct in the group with well differentiated tumors and in cases where the extent of the disease precludes adequate roentgen dosage.

MISCELLANEOUS AGENTS

The literature of the chemotherapy of cancer is full of enthusiastic preliminary notes which are not followed by fuller reports, indicating the premature and unsubstantiated nature of the original observations. It is not accidental that many of these reports deal with the rarer types of neoplasms, such as the lymphomas and the melanoma; apparently the unpredictable fluctuations and spontaneous remissions or slower progress of these neoplasms, as well as the occasional long survival of the patients, are not sufficiently recognized and appreciated.

It is unfortunate that no extensive group of untreated leukemias or lymphomas is available for comparison with the results achieved with various forms of therapy. The only available series in the American literature are those of Minot and his group (55, 56), and of Nathanson (57), based on relatively small numbers of cases and often confused by the fact that the patients had received other types of therapy. In addition, there is no good reference point from which to date the onset of illness in these patients. The date of onset is

based chiefly on history, with its known inaccuracies.

Woglom (1) and Karnofsky (3) recently have described some agents which were introduced with great expectations and which floundered upon more rigorous examination. To mention a few, avidin, as an antagonist to biotin, produced neither biotin deficiency nor any effect on 12 patients with neoplasms; heptaldehyde was ineffective in 11 patients with cancer; the promising clinical results purported to have been obtained in Russian experiments with the elusive endotoxin of *Trypanosoma cruzi* cannot be substantiated by American workers; cholchicine is apparently too toxic in man in amounts necessary for any favorable effect on tumors.

We have been interested in the report of Herbst and Bagley (58) indicating some retarding effects of inositol, ingested in daily amounts of 2 to 4 gm., in carcinoma of the urinary bladder. Garb (59) has reported remission in 4 cases of mycosis fungoides with tartar emetic or a pentavalent antimony preparation. In contrast with Bichel's (60) report that administration of *p*-aminobenzoic acid to 6 patients with leukemia increased the white cell count, Zarafonetis *et al.* (61) found diametrically opposite effects in 10 cases of leukemia. We (31) have given *p*-aminobenzoic acid, 2 gm. every two hours, to 1 patient with chronic lymphocytic leukemia, whose white blood cell count decreased during the therapy, and to 3 patients with monocytic leukemia, 2 of whom exhibited a drop in the white count during this period. In 2 patients severe stomatitis and glossitis were greatly improved. A chemical known to block melanin formation by inhibiting tyrosinase, monobenzyl ether of hydroquinone (62), has been given to 3 patients with malignant melanoma; the lesions appeared to progress more rapidly under this therapy than during control periods of observation.

At present, we are also exploring the effect of chymotrypsin (63) in carcinoma; 10 patients have shown no objective evidence of beneficial effect. Three patients with myelocytic leukemia, with marked increase in blood histamine, were placed on an antihistamine drug; with the doses employed, the white cell count rose during the period of experimental therapy in 2, and in a subleukemic leukemia, no change was elicited or coincidentally observed (64).

CONCLUSION

It must be admitted that the results of chemotherapy of cancer to date are, on the whole, disappointing. That progress is being made, is also impossible to deny. No one is more cognizant of the difficulties than those working in the field. The problems are not made easier by theoretical generalities and the understandable pressure for results from the generous public investment. Perhaps the most important psychological support of the investigators is the growing realization that neoplastic tissues, despite their gradation from the normal, are on the whole sufficiently different from normal tissues to enable one to postulate chemicals that may injure and destroy the former without seriously harming the latter.

The available chemicals showing some effect on the neoplastic tissues fall into four general classes: (*a*) those attacking some physiologically normal function still retained by the cancer cell, illustrated by iodine deposition by thyroid carcinoma; (*b*) those altering the biochemical substrate of the tumor, which still retains relative dependence on such environment, as the estrogens and androgens in mammary carcinoma; (*c*) the great group of bone marrow-lymphoid tissue-destructive or inhibiting agents, which also influence tumors derived from such tissues, including urethane, arsenic, benzene, and the amine mustards; (*d*) the agents which injure the vascular supply of the tumors, such as the *B. prodigiosus* polysaccharide. Further clarification of the mode of action of these compounds is important, and may well produce clues to more effective agents of the same general classes. It is of considerable interest that many of the agents that adversely affect some neoplasms, such

as arsenic, urethane, estrogens, and roentgen rays, also have carcinogenic properties.

It is to be hoped that any dissertation on the chemotherapy of cancer which now can be written will soon be of mere historical interest. Despite the seemingly unpromising nature of the problem, we agree with Haddow (2) in closing on a note of optimism, with the full conviction that effective agents against neoplastic diseases can and will be found.

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SUMARIO

Quimioterapia Experimental de las Afecciones Neoplásicas

Hay que reconocer que, hasta la fecha, los resultados de la quimioterapia en el cáncer han sido desalentadores, aunque tampoco cabe negar que se va logrando algún adelanto. Nadie se da cuenta mejor de las dificultades que los que luchan con el problema. Quizás el más importante apoyo psicológico encontrado por los investigadores consiste en la creciente comprensión de que los tejidos neoplásicos, a pesar de su gradación de lo normal, son, en conjunto, suficientemente distintos de los normales para vislumbrar la posibilidad de producir sustancias químicas que lesionen y destruyan los primeros sin afectar de gravedad los últimos.

Los productos químicos disponibles hoy día que muestran algún efecto sobre los tejidos neoplásicos corresponden a cuatro clases generales: (a) los que atacan alguna función normal residual de la célula cancerosa, siendo un ejemplo de ello los depósitos de yodo en el carcinoma tiroideo; (b) los que alteran el subsuelo biológico del tumor, el cual todavía está relativamente atenido a dicho ambiente, como pasa con los estrógenos y los andrógenos en el carcinoma mamario; (c) el gran grupo de agentes histolíticos o inhibidores de la médula ósea y el tejido linfoideo, que también afectan los tumores derivados de dichos tejidos, comprendiendo uretano, arsénico, benceno y las mostazas amínicas; (d) los agentes que lesionan el riego vascular de los tumores, tales como el polisacárido del *B. prodigiosus*. El esclarecimiento del modo de actuar de esos compuestos es importante y puede hasta aportar claves que conduzcan al descubrimiento de agentes más eficaces de las mismas clases generales. Es de interés el hecho de que muchos de los agentes que afectan adversamente algunas neoplasias como son el arsénico, el uretano, los estrógenos y los rayos X, también posean propiedades carcinógenas.

The Action of Steroid Hormones in Mammary Cancer[1]

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EVER SINCE ULRICH (1) and Loeser (2) first reported favorable changes in advanced mammary carcinoma following administration of testosterone, interest in this form of treatment has been increasing. The publications of Adair and his colleagues (3) have led to its widespread trial with reports of varied success (4). More recently British investigators (5) and Nathanson (6) have reported favorable effects from estrogen therapy in certain advanced cases of cancer of the breast.

The importance of these observations led several pharmaceutical manufacturers to request the Therapeutic Trials Committee of the Council on Pharmacy and Chemistry of the American Medical Association to institute a critical clinical study of the effects of hormone therapy in breast cancer. This request was made in the fall of 1946, but it was not until early in 1948 that the necessary planning of the investigation had been completed and a nucleus of collaborating clinics established. It will be apparent, therefore, that this report cannot concern itself with a detailed discussion of the results obtained in this study, since such reports as have become available to the Committee represent short periods of observation and are purely preliminary. The results which are to be presented must be considered merely indicative of trends not necessarily reflecting either quantitatively or qualitatively the conclusions which may be derived at the end of the study.

At this time it is believed that more can be gained by discussing the principles underlying the design of the study than by a review of the literature or detailed comment on cases reported by those engaged in this project. Furthermore, it would not be proper for one who has not personally observed the patients to discuss in any detail the observations of the participating investigators. This paper may be considered, therefore, as an introduction to future reports to be published by the Committee and by the individual collaborators.

A survey of the problem which was published by the Subcommittee charged with supervising this project (7) clearly showed the questions to which answers should be sought in the investigation of the efficacy of hormone therapy in mammary carcinoma. There seems little doubt that in some patients, either androgens or estrogens may bring about remarkable regression both of bony metastases and soft-tissue lesions. It should be noted that, in general, testosterone has proved more effective against bony metastases, and estrogen therapy has shown better results in causing regression of soft-tissue metastases. There is evidence, nevertheless, that testosterone can favorably influence soft-tissue lesions and that estrogens may bring about changes in bony lesions; at present, however, these appear to be exceptional responses. It is equally evident that many, if not a majority of patients, fail to respond to hormonal therapy in an objective manner, although varying degrees of subjective relief of symptoms may be observed. From these observations, there arise several questions to which answers must be found, forming the basis of this study.

Briefly, the important problems which may be amenable to solution in a large collaborative clinical study are the following:

(1) What proportion of patients with

[1] Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5–10, 1948.

[2] Secretary, Therapeutic Trials Committee, Council on Pharmacy and Chemistry, American Medical Association.

breast cancer and what manifestations of the disease will respond to hormone therapy with:

(*a*) Objective improvement?
(*b*) Subjective improvement?
(*c*) And under what conditions are these changes observed?

(2) In cases which respond, what effect has therapy on:

(*a*) Life expectancy?
(*b*) Comfort and activity?

(3) In the case of testosterone, what is the minimal effective dose and duration of treatment?

(4) Among the various estrogens, are some more effective than others?

(5) Are there any objective findings in the history, physical examination, early response to therapy, or pathologic characteristics of the tumor, which will enable one to predict the response in a given case of mammary carcinoma?

(6) What is the underlying mechanism of the action of these hormones on neoplastic disease?

It is obvious that, if the study is of sufficient magnitude and is continued for a sufficient period of time, the answers to the first four questions should be forthcoming automatically. Whether or not answers to the last two can be obtained is not now predictable.

The project instituted by the Therapeutic Trials Committee is designed to obtain the answers to the first four questions just posed in a minimum amount of time and simultaneously to permit the participating investigators to explore the problems posed by the last two questions with complete freedom and in any manner which they choose.

The success of this undertaking depends almost wholly upon the competence of the individual participants, and we have been fortunate in enlisting the collaboration of fifty clinics staffed by outstanding experts in the field of cancer.

In order to permit the participants in this project the maximum freedom to exercise their ingenuity and to explore without restriction the many facets of the problem, the Committee has restricted its activities to those phases wherein centralized planning is necessary to ensure the collection of data adequate in all major respects for pooling. To this end, there have been selected certain dosage schedules and products which all must use, and a scheme of uniform case reporting has been devised.

Since testosterone is still a costly material, it seems important to establish the minimum dosage for achieving satisfactory results. Four dosage schedules have been selected for study: 75 mg. weekly, 150 mg. weekly, 300 mg. weekly, and 600 mg. weekly, all administered in three divided doses during the week. Each investigator uses the "standard" schedule of 300 mg. weekly and compares it with one of the other schedules of his own choosing.

In the case of the estrogens, the problem is not primarily one of dosage but to determine, if possible, whether differences exist between the various compounds. Diethylstilbestrol in a dosage of 15 mg. daily has been chosen as a standard of reference and the investigators have been asked to make comparisons with one of the five following estrogens: ethinyl estradiol, 3 mg. daily; estradiol dipropionate, 5 mg. twice weekly; Premarin, 30 mg. daily; dienestrol, 15 mg. daily; the dimethyl ether of diethylstilbestrol, 30 mg. daily.

Because much of the evaluation of the results of this study will have to be made on the basis of the reports of clinical changes, changes demonstrated by repeated x-ray examination, and a classification of the original tumor, it is important to have the final evaluation performed in a uniform fashion by a group of competent authorities. The Subcommittee in charge of the project, composed of Dr. Ira Nathanson, *Chairman*, Dr. Willard Allen, Dr. Frank Adair, and Dr. Earl Engle, will evaluate the case reports and laboratory findings. A group of pathologists, comprising Dr. Howard Karsner, Dr. Fred Stewart, and Dr. Lauren Ackerman, will classify the

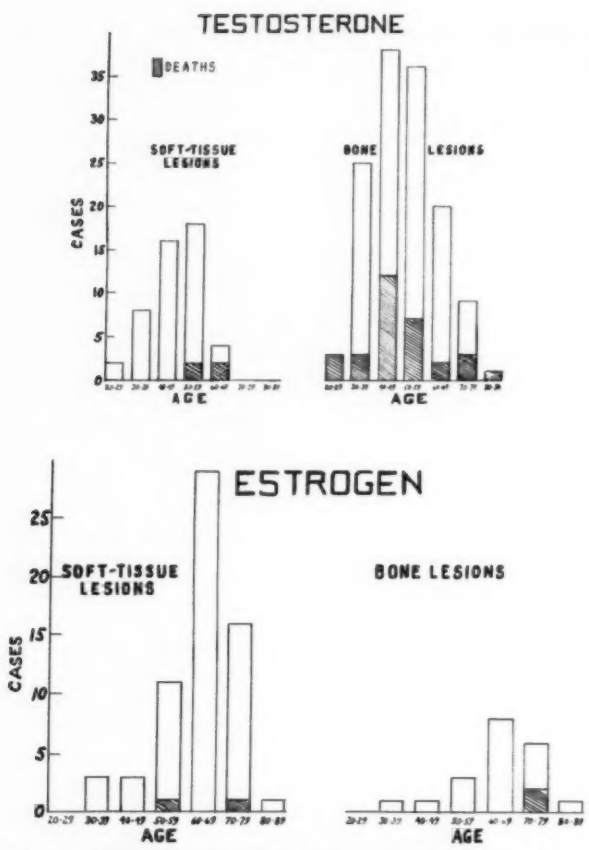

Fig. 1. Distribution of cases admitted to the collaborative study, according to age and type of therapy.

tumors from an examination of the submitted specimens and will also evaluate any changes in biopsy specimens obtained during treatment or in autopsy specimens from cases terminating fatally during or after hormone therapy. Finally, radiologic material will be evaluated by a group composed of Dr. L. Henry Garland, Dr. Merrill C. Sosman, and Dr. Leo G. Rigler.

All participating investigators report their cases to the Committee in a uniform fashion and perform certain minimal laboratory studies on each patient. Through the co-operation of the American Registry of Pathology, all pathologic specimens, duplicates of x-ray films, and duplicates of case records are being deposited at the Army Institute of Pathology, which provides a central point for review of the accumulated material by the evaluating groups. Aside from these requirements, the participating investigators have complete freedom to pursue whatever studies appear to them to be of interest and of importance.

Hormones are supplied by the Committee through the generosity of fourteen pharmaceutical manufacturers in this country and Canada.[3] Funds to support individual investigators have been obtained

[3] The collaborating firms are: Abbott Laboratories; Ayerst, McKenna & Harrison, Ltd.; Ciba Pharmaceutical Products, Inc.; Charles E. Frosst & Co. (Canada); Lakeside Laboratories, Inc.; Rare Chemicals, Inc.; Roche-Oreganon, Inc.; Schering Corporation; Schering Corporation, Ltd. (Canada); E. R. Squibb & Sons; The Upjohn Co.; Wallace & Tiernan Products, Inc.; White Laboratories, Inc.; Winthrop-Stearns, Inc.

from many sources, including the Committee on Growth and The National Advisory Cancer Council. Investigators have secured their own funds, with the Committee merely acting informally, in some instances, as an advisory body to the granting agency.

Since the first case report reached the Committee late in February 1948, more than 270 initial case reports have been received from investigators. The distribution of these cases by age and type of therapy is illustrated in Figure 1. It will be noted that the preponderance of cases treated with estrogen are in the older age groups; this by suggestion of the Committee. It seems established that estrogen therapy of menopausal or premenopausal women with breast cancer is a potentially dangerous procedure and can lead to rapid progression of the neoplastic process.

A point of importance, shown partly in Figure 2, is the fact that all of the cases admitted to the study have been judged by the participating investigators to be inoperable, and in the vast majority of cases radiation therapy has been administered sometime prior to admission and either no further benefit was being obtained or the lesions were so extensive as to make further irradiation impractical. It should be emphasized that none of the results to date indicate that hormone therapy can or should replace surgery or radiation therapy wherever these forms of treatment are indicated or feasible. It is of interest to note that of 270 cases on which initial reports have been submitted, the primary lesion was present in 72, but regarded as inoperable.

The results obtained to date as a function of the duration of hormone therapy are given in Figures 3 and 4. Only the 94 cases receiving testosterone on which follow-up reports have been submitted are discussed in detail. Too few estrogen-treated cases are available in this series to warrant extensive comment. No attempt has been made to differentiate, at this time, between the effects of various estrogens. All data are pooled and the figures presented, therefore, may be subject to considerable revision at a later date.

For the purpose of this report, subjective

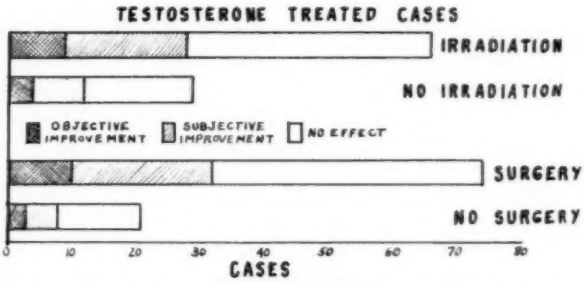

Fig. 2. Response to testosterone in relation to previous treatment of primary lesion with irradiation or surgery.

improvement was defined as marked relief of pain, usually evidenced by discontinuance or significant reduction in dosage of narcotics, marked increase in activity, particularly ambulation, or subsidence of complaints referable to the disease, or combinations of these. Although many patients reported increased "well-being" or showed moderate gains in weight, these were not regarded as constituting subjective improvement unless accompanied by one or more of the changes mentioned above.

Objective improvement was considered to have occurred when serial x-ray films showed recalcification of bony lesions or soft-tissue lesions disappeared or regressed significantly.

It should be pointed out that a bone lesion can be demonstrated to recalcify and disappear under therapy, while simul-

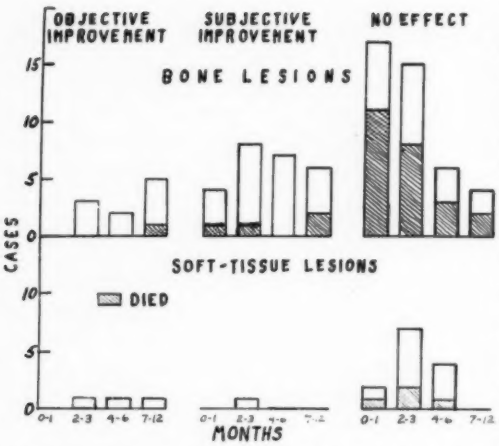

Fig. 3. Response of 94 testosterone-treated cases according to duration of therapy and type of metastasis.

taneously new lesions appear or old ones increase in size. Such cases were considered as objectively improved if the chief symptoms also subsided.

Figure 3 summarizes the results of testosterone therapy. Of the 77 cases reported as having bony metastases, 10, or 13 per cent, showed objective improvement after testosterone had been administered for from two to twelve months. Twenty-five cases, or 32 per cent, showed only subjective improvement over similar periods of time. Thus, it can be said that preliminary results in this small series of cases showed a favorable palliative response to testosterone in about 45 per cent of those treated.

In those cases with lesions in soft tissue only, the figures are too scattered to have much significance. Only 17 cases are reported, and although the number showing objective improvement is comparable to that of the group having bony lesions, the number having subjective relief is far less. This is not surprising, since pain is an outstanding feature of bony metastases and is less predominant in the soft-tissue lesions.

Attention is called to the mortality figures, which indicate clearly that many of the cases were moribund on admission to the study, dying within a few weeks or months. It should also be noted that objective improvement, when it occurs, usually does not manifest itself for at least three months after the treatment is begun. If the patients dying in the first month of therapy are eliminated, the percentage of favorable response to therapy is greatly increased.

The data have also been analyzed from the standpoint of the relation of the response to the age of the patient. Although, at this time, no apparent relationship exists, it should be noted that there is a skew distribution of cases, more in the younger group receiving testosterone. This must be taken into account in the final analysis of the data. Furthermore, the available data do not reveal any correlation between duration of the disease and response to testosterone therapy or between age of the patient and the response to treatment. The series is too small, however, to state that such a relationship might not exist.

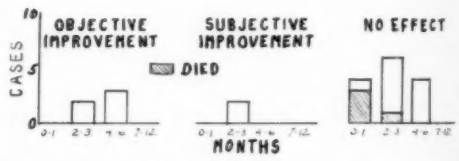

Fig. 4. Response of 21 estrogen-treated cases according to duration of therapy.

The figures for the results of estrogen therapy are presented with some hesitancy. Data on only 21 cases have been obtained, too few to have any significance. It can be remarked, however, that objective improvement, principally healing of ulcers, disappearance of palpable lymph nodes, regression of lung lesions, and decrease in the size of livers suspected of containing metastatic deposits, have been noted.

No comment can be made, of course, on the effect of hormone therapy on the extension of life expectancy. It is not believed that even the most enthusiastic proponent of hormone therapy of breast cancer feels that patients with malignant lesions can be cured by this form of treatment. It may be possible, however, in suitable cases to prolong life and it seems

quite probable that many patients can be made comfortable and relatively happy during the greater part of the time, even though they die of their disease at precisely the time they would have died had they not received treatment. In other words, it seems probable that in some patients the hormones may be an additional palliative measure which may be used either when surgery and irradiation are not available or when no further benefit can be expected from them. Certainly, at this time, there is nothing to indicate that hormone therapy can replace the accepted methods of treatment. Furthermore, this form of therapy is still highly experimental and the use of hormones in the management of breast cancer, although it probably does have a place, is still poorly defined.

In connection with the reporting of the effect of therapy on the survival of patients with cancer, the Subcommittee on Steroids and Cancer is giving consideration to reporting in terms of percentage of normal life expectancy rather than in terms of arbitrary three or five year "cures." It is obvious that a five-year survival in a woman aged sixty-five is of a different significance than a five-year survival in a woman aged thirty. The age factor is of importance in the evaluation of results of cancer therapy, and it is believed that the introduction of the factor of "life expectancy" into this evaluation will result in a more realistic appraisal of the results of therapy.

SUMMARY

1. A brief description of a collaborative study on estrogens and androgens now being conducted under the auspices of the Therapeutic Trials Committee of the Council on Pharmacy and Chemistry of the American Medical Association has been presented.

2. Of 77 cases of breast cancer with bony metastases which have received up to one years treatment, 45 per cent have shown a favorable response to testosterone therapy, although only 13 per cent have shown objective improvement.

3. The results of testosterone therapy in 17 cases of breast cancer with only soft-tissue lesions show a similar incidence of objective improvement, but the degree of subjective response is significantly lower than in the cases with bony metastases.

4. Of 21 patients with breast cancer receiving estrogen therapy, 5 showed objective improvement.

5. It is to be emphasized that these results are purely preliminary and will undoubtedly be altered as the study progresses.

6. At this time, it is not possible to define the place of hormone therapy in breast cancer except to state that it may be tried when all other forms of therapy have been given a full and adequate trial and have failed. Neither androgens nor estrogens should be used in lieu of surgical measures or irradiation.

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SUMARIO

La Acción de las Hormonas Esteroideas en el Cáncer Mamario

Esta breve reseña versa sobre el estudio colaborativo acerca de estrógenos y andrógenos que se lleva a cabo bajo los auspicios de la Comisión de Ensayos Terapéuticos del Consejo de Farmacia y Química de la Asociación Médica Americana.

De 77 casos de cáncer mamario con metástasis óseas que han recibido hasta un año de tratamiento, 45 por ciento han revelado respuesta favorable a la testosteronoterapia, aunque sólo 13 por ciento han mostrado mejoría objetiva.

El resultado de la testosteronoterapia en 17 casos de cáncer mamario con meras lesiones de los tejidos blandos revelan una incidencia similar de mejoría objetiva, pero el grado de respuesta subjetiva es significativamente menor que en los casos con metástasis óseas.

De 21 enfermas con cáncer mamario que recibieron estrogenoterapia, 5 revelaron mejoría objetiva.

Estos resultados son puramente preliminares y serán sin duda modificados a medida que avance el estudio.

Por ahora, no es posible determinar el puesto de la hormonoterapia en el cáncer mamario, salvo para afirmar que puede probarse cuando todas las demás formas de terapéutica han sido objeto de pleno y adecuado ensayo y han fracasado. Ni los andrógenos ni los estrógenos deben ser usados en lugar de las medidas quirúrgicas o de la irradiación.

DISCUSSION

(Papers by Shimkin and Bierman; Van Winkle)

Henry S. Kaplan, M.D. (San Francisco): It is a privilege to be asked to discuss these interesting papers. In their comprehensive presentation, Doctors Shimkin and Bierman have very considerately dealt with surgery and radiation therapy as well as with chemotherapy of neoplastic diseases. It is difficult for those of us engaged in radiation therapy to keep pace with this rapidly developing field, and we all tend either to over-emphasize the achievements of the chemotherapeutic agents or, perhaps as a reaction, to reassert the value of radiation therapy in the treatment of cancer, possibly exaggerating its importance in the process. In their sound and thoughtful comments, Doctor Shimkin and Doctor Bierman have helped to place the whole subject in its proper perspective.

One point for discussion is concerned with scientific method as applied here. It is difficult for us to deal with patients with the same scientific objectivity with which we can handle mice or other laboratory animals. Many of the newer chemotherapeutic agents have not yet received an adequate clinical trial and their value will not be fully established for some time to come. During this period of trial, therefore, it is essential that they be employed in as objective and careful a way as possible. All too often, however, pressure is placed upon us as radiation therapists to administer x-ray or radium treatment to patients with advanced malignant disease during the period when they also are being treated with an experimental drug. We are all aware, I am sure, of the scientific pitfalls which such combined treatment may—and often does—lead to, and I should like merely to register another plea for withholding radiation whenever possible in such instances.

Secondly, we are all too prone to think of radiation, surgery, and chemotherapy as competing with one another in the treatment of malignant disease. Little attention has been directed to the hypothesis that chemotherapeutic agents and radiation therapy can be combined,

with advantage to the patient. It is not beyond the realm of possibility that some of the chemotherapeutic agents will find their greatest usefulness as radiation sensitizers, capable of enhancing the response of tumors of given types to effective doses of irradiation. While this possibility has only begun to receive experimental attention, it is interesting that in a recent paper by Irene Corey Diller, the combined effect of the bacterial polysaccharide and irradiation therapy in a small group of tumor-bearing mice seemed to be considerably greater than that of either agent alone. Much physical research has been done to improve x-ray equipment and to make possible the delivery of greater and greater amounts of radiation to the depths of the body. In contrast to these technical advances, there has been little or no increase in our ability to alter selectively the radiosensitivity of the tumors which we are called upon to treat. The possibility of a selective and controlled chemotherapeutic alteration of radiosensitivity as a preliminary to radiation therapy is an extremely attractive one which must receive intensive study in experimental laboratories in the near future.

Dr. Van Winkle has given us a preliminary report on the comprehensive study being conducted by the Subcommittee on Steroids and Cancer. I must admit that I had many misgivings about this project on first hearing of it, but his remarks indicate that the Committee is well aware of the many pitfalls involved. In future reports, it would be well to continue to emphasize the possible sources of error so that others less sophisticated in evaluation of scientific work will not be led to believe that the results are cut and dried.

In this connection I should like to ask Dr. Van Winkle how the Committee proposes to study changes in life expectancy? To the best of my knowledge, there is no base-line information for survival time in a comparable series of cases, and comparison with the older data of Nathanson and Welch would not be suitable.

Another question that arises is the uniformity of the steroid preparations supplied by different manufacturers. I am sure, however, that this source of error has already received consideration by the Committee.

Finally, with regard to the mechanisms by which these agents act, I am sure that we have all been puzzled at the apparent paradox that both male and female sex hormones may have beneficial effect in these cases. It will be some time before this mystery is cleared up. A partial explanation may lie in the fact that large doses of female sex hormones, as Gardner and others have shown, reverse the usual estrogenic effects and inhibit the development of secondary sex characters in experimental animals. The action of testosterone is less clear but may be related to its metabolic effect on bone rather than to any direct effect on these neoplasms.

B. V. Low-Beer, M.D. (San Francisco): One year ago, in December 1947, at the panel discussion of radiation therapy at the Society's meeting in Boston, someone in the audience raised the question as to whether chemotherapeutic agents, particularly nitrogen mustard, were going to replace radiation therapy in the treatment of Hodgkin's disease, leukemias, and lymphomas. The chairman, Dr. Newell, and the members of the panel were rather hesitant to answer the question for two reasons: First, none of the members had seen an appreciable number of cases of any one disease group which had been treated with chemotherapeutic agents; second, the time for comparative evaluation of nitrogen mustard and radiation therapy seemed to us to be too short to provide reliable conclusions. You may recall that this was the time when enthusiastic articles were appearing in medical journals, and chemotherapy of cancer was headline news in the daily press.

Today Dr. Shimkin has drawn upon his wide experience and has given a clear analysis of the question which we were unable to discuss conclusively a year ago. I wish to commend him for his presentation of this subject. I for one have been very much interested in the therapeutic value of nitrogen mustard compounds and I have advocated their use to our group at hematological conferences at the University of California Hospital in previously untreated cases of Hodgkin's disease, leukemia, and lymphoma. I believe that proper evaluation of their effectiveness is possible only through their primary use.

Dr. Shimkin and Dr. Kaplan have referred to the combination of nitrogen mustard and radiation therapy. We have followed a few patients treated by this method and we have come to the conclusion that there is no added benefit from such combined treatment. The problem of radiation dosage is difficult enough by itself, and combination with another type of treatment, about which we know even less than we do about ionizing radiation, seems unwarranted at this time. At present I object to simultaneous use of radiation and nitrogen mustard therapy, and I agree with Dr. Chamberlain that nitrogen mustard should be used only in systemic lesions, and not in a localized disease.

It has been stated often that nitrogen mustard is a sensitizing agent to radiation and that patients who no longer respond to radiation therapy will do so again after treatment with nitrogen mustard. Apparently nitrogen mustard is a systemic cellular poison which affects all metabolic processes. One may postulate that, in such a state of disturbed biochemical equilibrium, cells are more responsive to radiation. In our

experience, no significant increase of radiosensitivity has resulted from the use of nitrogen mustard in long standing, so-called "burned out" cases of Hodgkin's disease or cutaneous lymphoma. In conclusion I wish to say that nitrogen mustard as it is used at present is a very drastic therapeutic agent with an extremely narrow safety margin. To those persons who advocate administration of nitrogen mustard to ambulatory patients, I have only one suggestion—that they once submit themselves to this treatment. I believe that radiologists will wish to continue in a spirit of scientific curiosity to seek greater knowledge of any therapeutic method which may be superior to ionizing radiations.

With reference to Dr. Van Winkle's very interesting presentation, I should mention that at the University of California Hospital a cooperative project for the study of patients with advanced breast cancer under estrogenic and androgenic hormone therapy has been in progress for two and a half years. We have not yet reached a final conclusion, and I believe that it will take a long time to do so. Radiation therapy is apparently still the most important measure for the control, at least temporarily, of lesions in patients with advanced breast cancer. Appropriate and more effective use of hormones and chemotherapy will come only through a better understanding of the site and the mode of action of these agents in animals and human beings.

William Y. Burton, M.D. (Portland, Ore.): The Division of Radiology at the University of Oregon Medical School represents one of the collaborating clinics that Dr. Van Winkle mentioned. Our dosages of testosterone have been 75 mg. and 300 mg. weekly. In the case of estrogens, we have used Diethylstilbestrol, 15 mg. daily or Lynoral (ethinyl estradiol), 3 mg. daily. Almost all of our patients have had radical surgery and x-ray therapy preceding the hormone treatment. Our percentage showing objective and subjective improvement, runs somewhat higher than the overall results reported by Dr. Van Winkle.

I think it should be emphasized that in our clinic we do not use testosterone therapy for metastatic bone lesions until deep x-ray therapy has been given locally and the ovaries have been irradiated. Very often, the response to roentgen castration and local x-ray therapy is quite dramatic, and this treatment has been used for many years. In a certain percentage of cases, the bone lesions will fill in after x-ray treatment, and the pain will completely disappear. This group of patients, when treated before the menopause, will have some mild menopausal symptoms, but not the disagreeable side-effects that are seen in women who receive testosterone therapy. The disagreeable side-effects of hormonal therapy can become so severe that the patients will refuse the medication and accept the pain in preference. In other words, the tried methods of surgery and irradiation should be used before resorting to hormones.

I think that Dr. Van Winkle should be complimented on the manner in which he is coordinating this study and also on the conservative way in which he emphasizes that the reported results are purely preliminary and undoubtedly will be altered as the study progresses.

Henry J. Ullmann, M.D. (Santa Barbara, Calif.): Unfortunately I have not the references here with me, but the work of Bischoff and his co-workers at Santa Barbara has shown that estrogens or androgens given to animals three or more times a day will produce three to four times the effect obtained when they are given less often. For that reason, I have been giving testosterone as methyl testosterone by mouth, 30 to 60 mg., divided into four doses a day, Where I have had results, they have been spectacular, just as those obtained by deep muscular injections of testosterone propionate. It is much easier to take methyl testosterone by mouth three or four times a day than to come to the office for injections. This discussion reminds me very much of our early discussions of new methods of treatment, which often showed either spectacular results or none at all. It brings back old times.

Lawrence Knox, M.D. (Pacific Palisades, Calif.): I have been impressed with the violence we have been doing to the human body for so long, and am again impressed with the extreme toxicity of the materials which we are using in an attempt to find our way out of the woods in regard to neoplasms. Our present tendency seems to be toward bigger and better and more toxic methods.

I would like to have us think, for just a moment, about the approach to a disease—if we can call cancer a disease—in which the picture is basically degenerative. It seems to me that we would do well to fall back on one criterion, regardless of the particular method we decide to use: Do we have some concept of what a normal functioning adult body is, and should we not attempt in some way to follow nature's lead in restoring a body which has degenerated to the point where it can produce a neoplasm? Have we not now reached the place where we should investigate what happens in a body before it can produce a cancer?

The use of estrogens and of testosterone in large quantities—many times larger than the normal balance of the body ever requires, even to the point where water retention is affected—is in a confused state. While most neoplasms occur in bodies that have lost the normal balance of their own sex hormone (diminished testosterone in the male and diminished estrogen in the female), we

further increase the disbalance by administering testosterone to women and estrogens to men. While we are doing these things, which are doubtless of value because they relieve pain, I believe we should be seeking an answer to our problem. I think, also, that we should move in the direction of thinking medically rather than surgically. For many years we have used violence against the body in attempting to destroy cancer. I have not yet reached the place where I am hopeless regarding the possibility of so treating the body that we can prevent the formation of cancer or building up its constitutional level above the theoretical place where cancer can be produced.

Dr. Shimkin (*closing*): I want to thank the discussers of this paper for their comments and additions. I think Dr. Kaplan emphasized a very important point. Investigations of experimental chemotherapy of cancer can be pursued adequately only through close cooperation and intimate contact with the radiologists and the surgeons in whose hands the primary responsibility of managing patients with cancer so firmly remains. It becomes impossible, however, to evaluate many agents for their effect on cancer if several types of therapy are superimposed. Clear answers can be procured only in cases whose management is not confused by several types of therapy. The selection of such cases for the best interest of the patients and the study must be done in association with the radiologists and surgeons.

Dr. Van Winkle (*closing*): I appreciate the remarks that have been made. In reply to the two questions raised by Dr. Kaplan: First, in regard to the evaluation of life expectancy; he put his finger on a very difficult problem. We recognize the inadequacy of the past statistics. We are approaching the problem in two ways. We are collecting current data, and through the cooperation of our Bureau of Medical Economic Research analyzing them. Competent actuarial figures on cancer have to be collected piecemeal, and I can't say we will be successful in getting anything. We also have two or three clinics treating alternate cases and leaving untreated the other cases. We cannot, of course, build up a large series of controls in this manner. We appreciate very strongly the difficulties that exist in the estimation of life expectancy.

As to the uniformity of the hormone material: we have the cooperation of the Food and Drug Administration, who will examine, or spot-check, batches from the various manufacturers, not only by chemical examination, but by assays by the usual methods in rats. This is done without knowledge of either the manufacturers or the consignee. We will continue to do this in order to be sure that the material used is uniform. With one exception, all of the preparations we are using are crystalline. Premarin is not, as you know. It has a variable composition.

Finally I would like to advise caution in the use of these hormones. They are potent materials. They may be dangerous if mishandled. For example, Dr. Nathanson has just written me that he is convinced that a few of his cases on testosterone have progressed under treatment. Although patients feel fine and have been able to get out of bed and carry on normal activities, the lesions seem to progress somewhat faster than would be expected without therapy, the course is suddenly down-hill and death usually occurs within a week or two. The selection of cases for this type of therapy is very important, and it is certainly not a procedure for general utilization at this time nor will it be for a matter of several years.

Nephrography

Experimental and Clinical Observations[1]

ROBERT S. LEIGHTON, M.D.[2]

SINCE THE INTRODUCTION of intravenous urography by Swick and Lichtenberg (1–5) and the refinement of the method by a host of others, this procedure has become indispensable in the field of urologic diagnosis. The original workers noted the intensification of the shadow of the renal parenchyma on films taken in the course of excretory urography, and Lichtenberg (3) introduced the term nephrography, but felt that insufficient contrast was possible for this nephrographic effect to be of diagnostic value except in the presence of very gross lesions. He describes the experiments of Lenarduzzi and Pecco, who performed intravenous urography after ligating the ureters of animals in order to increase the concentration of the dye in the renal calices and pelvis. They did not notice any definite parenchymal effect. Sgalitzer (6) observed an absence of opacification of the parenchyma of the upper part of one kidney on a set of human urograms, and reported that this was apparently due to a hypernephroma in that area. His case was proved at autopsy. No attempt had been made, aside from external compression, to accentuate the parenchymal effect. Ravasini (7) described areas of failure of opacification in cases of abscess and tuberculous cavity in the kidney. No illustrations accompanied either Sgalitzer's or Ravasini's report, however, so that their findings are difficult to evaluate. Boeminghaus (8) discussed the problem of diagnosis by means of nephrography and noted that changes could sometimes be made out on urograms, but was very skeptical of the practical importance of such findings.

In 1932, Wesson and Fulmer (9) and Florence, Howland, and Weens (15) noted a marked increase in opacification of the renal parenchyma when intravenous urography was performed in the presence of acute ureteral obstruction due to stone. Since their description of this phenomenon, the so-called "spontaneous nephrogram" has been generally used as a secondary indication of acute ureteral obstruction.

Hellmer (10) was the first author to summarize the material available and to publish cases indicating that nephrography offered promise of specific diagnostic value. He described several factors which he felt would limit or enhance the possibilities of nephrography as a method of diagnosing parenchymal lesions in the kidney. These were: (1) the saturation of the contrast medium in the renal parenchyma; (2) the magnitude of the pathological area; (3) the degree of circumscription of the pathology in the kidney. Hellmer presented two cases of parenchymal disease. The first was a tumor in the lower pole of the right kidney, beautifully demonstrated as an area of lessened density in the parenchyma, the ureteral obstruction in this instance being due to blood clots in the renal pelvis and ureter. His second case showed almost identical findings except for their location. The lesion in the second case proved to be a large solitary cyst. Hellmer also shows several examples of nephrograms of normal kidneys, in which the renal pelvis, peripelvic fat, and blood vessels are clearly demarcated from the secretory tissue. He felt that this indicated the possibility of definite structural diagnosis by means of the nephrogram. In one of his cases, a double kidney pelvis and ureter were present, with a stone obstructing one of the two ureters on one side. In this case the increase in contrast caused

[1] From the Department of Radiology and Physical Therapy, University of Minnesota Hospitals, Minneapolis, Minnesota. Accepted for publication in September 1948.

[2] Trainee of the National Cancer Institute.

by the ureteral obstruction is beautifully brought out.

Hellmer's work depended either on accidental ureteral obstruction or external compression. He describes no attempt at internal obstruction for the purpose of enhancing the nephrographic effect.

Wolffe (11) described cases showing multiple small areas of decreased density within the kidney parenchyma on the excretory urogram in a case of thrombosis of small branches of the renal artery. These findings were associated with a normal retrograde pyelogram. The illustrations in his article are rather poor, making his findings difficult to evaluate.

As far as the author has been able to determine, Hickel (12, 13) was the first to describe a method of internally obstructing the ureter and thus accentuating the nephrographic effect of excretory urography. His method involves inserting a catheter into the ureter and connecting this catheter to a reservoir of fluid in such a manner that a constant hydrostatic pressure on the kidney pelvis is maintained. He has been able to produce a number of excellent normal nephrograms by this method, but has not yet published any pathological material.

Weens and Florence (14) were the first to publish an account of a simple method of nephrography by means of ureteral obstruction. At the time their work was published, the author had independently developed and was then using a very similar procedure. The method of Weens and Florence consists of the introduction of a Dourmaskin catheter into the ureter and inflation of the dilating bag with 0.5 c.c. of mercury. Following this, they make intravenous urograms using 30 to 35 c.c. of 35 per cent diodrast. They describe their findings in 8 patients, in 6 of whom normal kidneys were demonstrated and in 2 hydronephrosis. They have published no instances of parenchymal pathology.

The experience of all investigators indicates that the crux of the problem of nephrography as a diagnostic method lies in the possibility of obtaining sufficient contrast on the nephrogram between normal and pathologic tissue so that diagnoses may be made with reasonable assurance. The problem of overlying shadows of the bowel is, of course, of much greater importance in nephrography than in those procedures where the attempt is made to outline only those structures distal to the collecting tubules. It appears that until someone develops a better method of eliminating these superimposed shadows, a certain number of failures must be expected. Body-section roentgenography of the kidneys in conjunction with intravenous urography and ureteral obstruction offers a promise of definite value in this respect, but has not as yet been adequately investigated.

AN EXPERIMENTAL APPROACH TO THE PROBLEM OF NEPHROGRAPHY

The present study was undertaken in an effort to determine whether nephrography deserves a definite place in our diagnostic armamentarium or whether demonstration of lesions on a nephrogram should be considered merely as an occasional phenomenon of little value. It seemed fairly obvious that the size of the lesion which might be demonstrated, its shape, and demarcation from the surrounding normal tissue would be of primary importance. It was therefore decided to produce artificially various lesions in the kidneys of dogs and to see how well these could be demonstrated on nephrograms.

The methods used in producing lesions in dog kidneys were infarction by means of arterial ligation, excision of small portions of the kidney parenchyma, injection of necrotizing solutions into the kidney parenchyma, and destruction of portions of the kidney by limited transmission of electric current. The method of infarction caused a very useful lesion, an example of which will be described later in this paper. This method was abandoned, however, because it was found to be technically impossible to cause an infarct involving less than one-third of the kidney. Surgical excision proved to be unsatisfactory because of

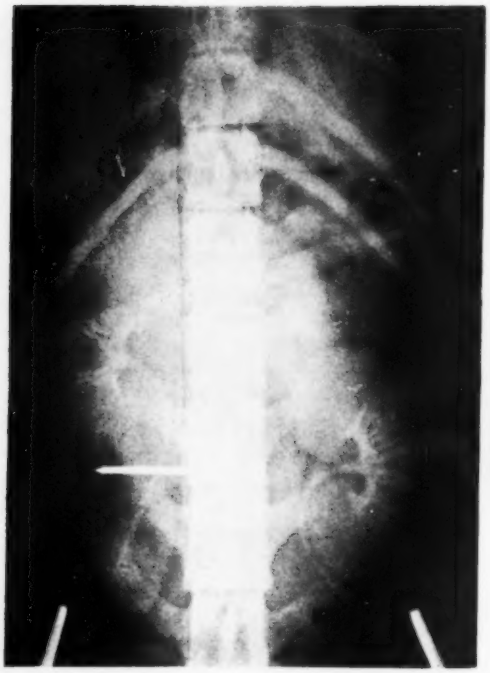


Fig. 1. Bilateral nephrogram in a normal dog.

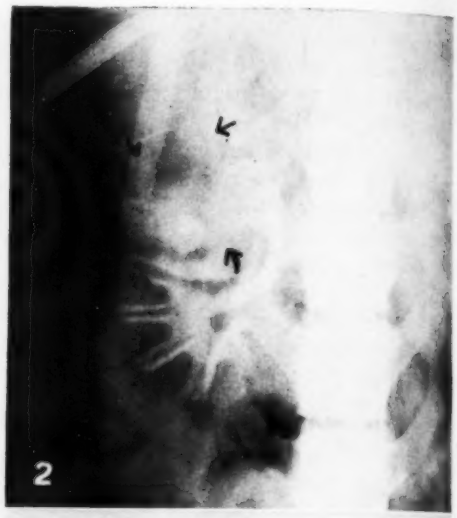


Fig. 2. Nephrogram of right kidney in a dog. Large infarct at upper pole shows area of decreased density (arrows).

Fig. 3. Photograph of the kidney shown by nephrography in Fig. 2. Note the close correlation of the gross anatomy of the infarct with the nephrogram.

technical difficulties which made a lesion of appropriate size almost impossible of achievement. The injection of foreign body suspensions and necrotizing solutions, such as phenol, was also unsatisfactory, because of the peculiar physical nature of kidney tissue.

The method finally developed, which so far appears to be highly satisfactory in all respects, involves the passage of an electric current through the kidney tissue in such a way as to cause limited areas of devitalization. This is done by inserting two fine straight needles through the kidney in such a way that they are parallel and at a distance from each other equal to the size of the lesion desired. A unipolar current of 10 ma. from a battery source is then passed through the tissue between the needles for about five minutes. This procedure is accomplished through an abdominal incision and the dog is allowed to recover. After the abdominal wound is healed, reoperation is done, with small flank incisions, and the ureters are exposed retroperitoneally. Loose ligatures are looped about each ureter and brought out through the skin of the flank, and the flank incisions are closed. The ligatures are then tied tightly on the skin to obstruct the ureters and intravenous urography is performed. The procedure of leading the ligatures out through the skin makes it possible to restore the continuity of the ureter without reoperation. The ureters were approached retroperitoneally to avoid the pneumoperitoneum associated with laparotomy, which caused confusing shadows on the nephrograms. It has been found that it is necessary to wait for some

time to allow the renal pelvis and ureter above the ligature to fill with urine so that the dye will be held back in the kidney parenchyma as the kidneys remove it from the blood. After some experimentation, it was found that about fifteen minutes should be allowed to elapse between the time of ureteral ligation and intravenous administration of the dye. In the making of the films reproduced in this paper, 12 to 15 c.c. of 35 per cent diodrast was used on medium-sized dogs.

Results in Animal Experiments: Figure 1 shows the kidneys of a normal dog clearly brought out by means of nephrography. This case is included as a normal for comparison. The dog had no lesions in the kidney.

Figure 2 is a nephrogram made on a dog following the production of a large infarct at the upper pole of the right kidney. It will be noted that the kidney outline is lost and there is failure of opacification in this area. Figure 3 is a photograph of the excised right kidney showing the lesion demonstrated in Figure 2.

Figure 4 is a left-sided nephrogram in a dog showing two wedge-shaped areas of decreased density in the kidney parenchyma. These areas of non-functioning tissue were caused by the electrical method described above. Figure 5 is a photograph of the left kidney after removal, showing the lesions which were demonstrated by nephrography in Figure 4. The close correlation between the gross pathological anatomy and the nephrogram is clearly apparent.

Discussion: It appears reasonable to conclude from the above findings that lesions of the kidney parenchyma which do not involve or deform the renal calices and pelvis can be adequately demonstrated by means of nephrography. These results, however, cannot be accepted as indicating any consistency or reliability for the method, since not a sufficient number of cases has been examined to allow for any conclusions on this problem. The fact that small lesions have been demonstrated, however, does warrant further clinical and experimental investigation of the method.

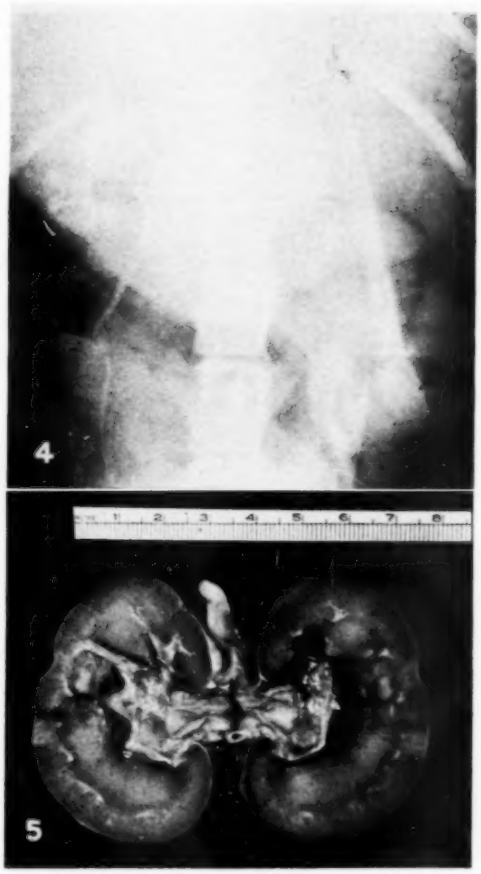


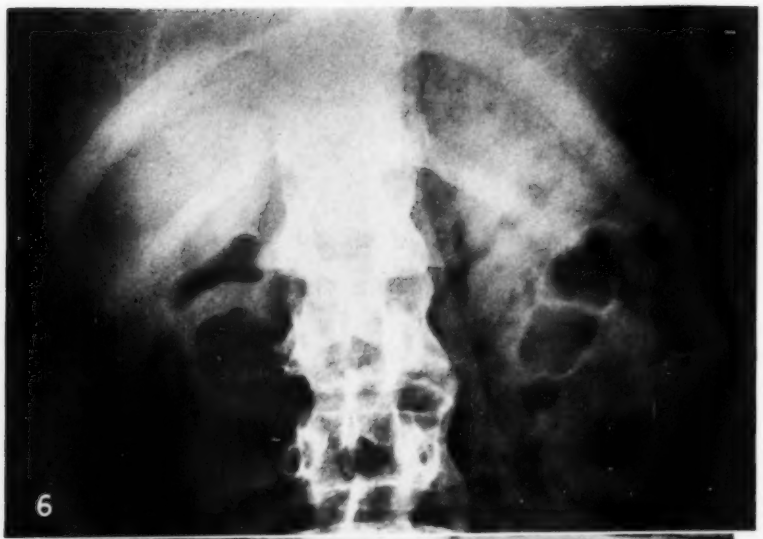
Fig. 4. Nephrogram in a dog after fulguration of segments of the left kidney. Note defects in shadow (arrows) indicating non-functioning areas.

Fig. 5. Photograph of kidney shown by nephrography in Figure 4. Note scars which produced defects in nephrogram.

A METHOD OF NEPHROGRAPHY IN HUMAN SUBJECTS

Reference has been made in the first part of this paper to the work of Florence and Howland (15), Wesson and Fulmer (9), and Hickel (12, 13). It has also been noted that Weens and Florence (14) reported a method of human nephrography virtually identical with that of the present author, although independently developed.

In the nephrograms made on human subjects in the course of this study, a catheter has been developed with the assistance of Dr. John Wild of the Department of



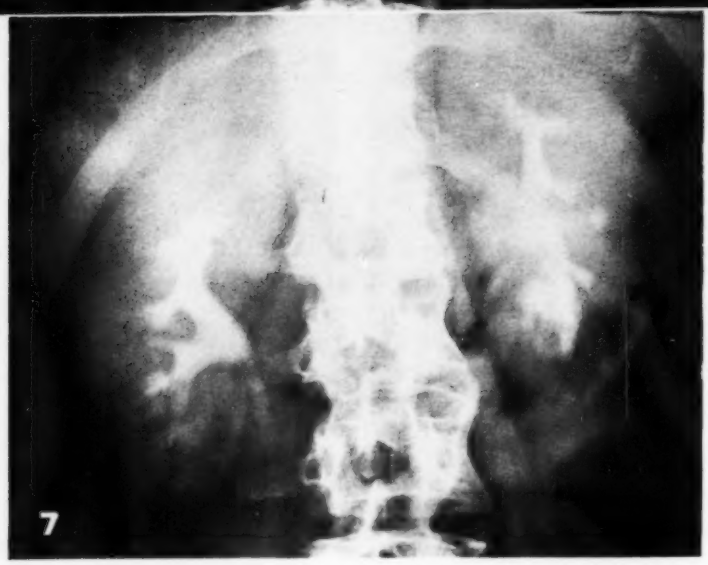


Fig. 6. Roentgenogram of kidney area in human subject.
Fig. 7. Bilateral nephrograms in the same patient shown in Figure 6. Kidneys are normal. Note the typical increase in density.

Surgery, University of Minnesota Medical School, which appears to have certain advantages over the occlusive instruments used elsewhere. A number 4 or 5 radiopaque ureteral catheter is fitted with a thin latex sheath, long enough to cover the holes at and near the tip. This sheath is tied over the catheter with fine silk, using a whip knot. The sheath was designed and the latex work done by Dr. Wild. It has been found that the addition of this covering does not appreciably increase the diameter of the ureteral catheter, and, since it is snug-fitted, it does not introduce any additional difficulty in ureteral catheterization. So that the proximal end of the catheter may be conveniently occluded by means of a hemostat, a short length of

soft rubber urethral catheter is tied over that end. This apparatus has been found to be cheap, readily available, and capable of accurate reproduction.

In practice, the patient is prepared for intravenous urography and cystoscopy and the occlusive catheter is introduced so that the tip lies in the abdominal portion of the ureter. The latex sheath is then distended with 0.5 c.c. of skiodan. After a wait of fifteen or twenty minutes to allow the development of suitable urinary back-pressure in the pelvis and upper ureter, 20 c.c. of 35 per cent diodrast or neo-

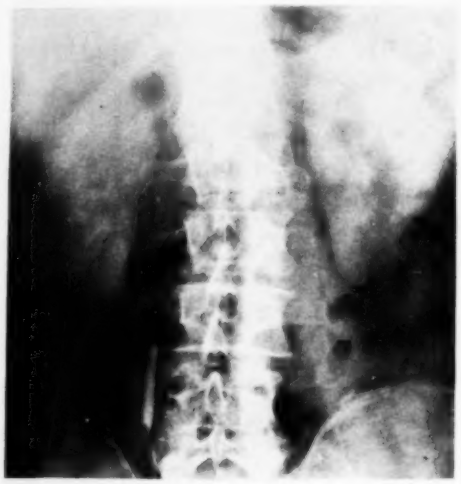


Fig. 8. Roentgenogram of the renal area. Occlusive bag with 2 c.c. fluid seen in lower right ureter.

iopax is administered intravenously. Films of the urinary tract are then made at five-, ten-, and twenty-minute intervals after injection, although in the exceptional case films up to forty- or fifty-minute intervals may be desirable.

In some of the earlier cases, as much as 1.5 c.c. of liquid was used in the occluding sheath, and several of these patients experienced rather severe renal colic. Since only 0.5 c.c. of liquid has been used in the sac, however, pain has not been severe, nor have there been any reactions which were felt to be a contraindication to the procedure.

Figure 6 is a roentgenogram of the kidney area in a patient in whom the kidney outlines were well made out. Figure 7 shows bilateral nephrograms on this same patient. The marked opacification of the kidney parenchyma as well as an excellent pyelogram is demonstrated. No evidence of disease could be discovered on these films.

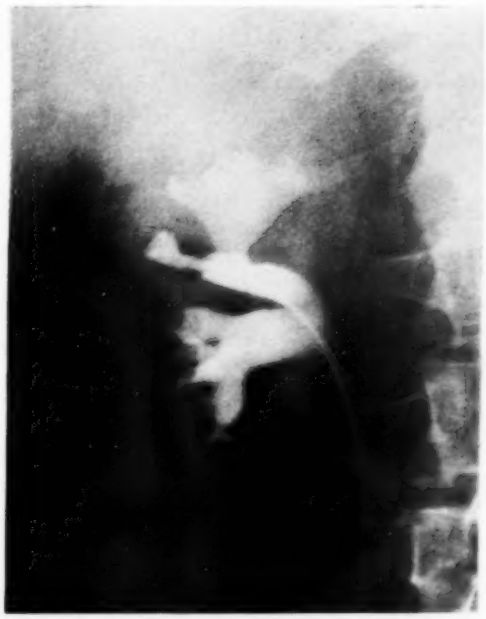


Fig. 9. Retrograde pyelogram, same case as Fig. 8, showing deformity of superior major calyx.

Figure 8 shows another case in which the kidneys are well made out on the plain film. The occlusive bag can be seen in the right lower ureter. (In this case 2 c.c. of liquid was used in the bag.) Figure 9 is a retrograde pyelogram showing marked flattening and widening of the superior major calyx of the right kidney, which was presumed to be due to either a tumor or a cyst. Nephrography was done in this case and the result is shown in Figure 10. The widened and flattened superior major calyx is faintly shown, and the greater part of the kidney parenchyma is densely opacified. In the vicinity of the pelvic deformity, however, there is a large area of failure of opacification, demonstrating the presence of a non-functioning mass within

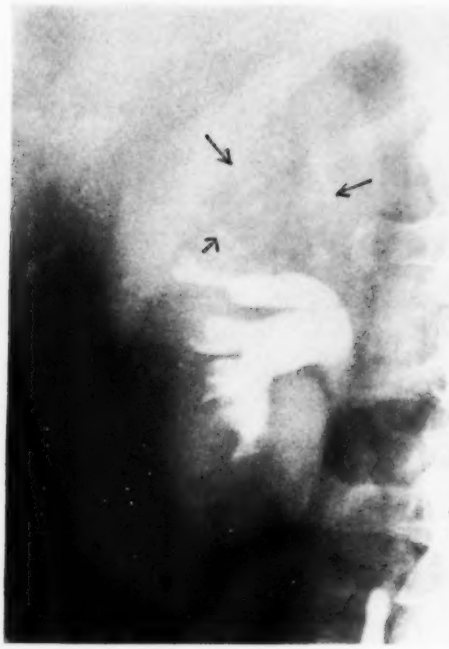


Fig. 10. Nephrogram in the case shown in Figs 8 and 9. A non-functioning area corresponding to the caliceal deformity is indicated by the low density of the shadow in this segment (arrows).

the kidney parenchyma at this point. The peripelvic fat and blood vessels are also differentiated from the functioning kidney in this film.

DISCUSSION

The findings described in the above-mentioned animal and human subjects indicate that nephrography offers definite possibilities as a useful method for demonstrating circumscribed lesions within the kidney parenchyma before these lesions have attained sufficient size to cause caliceal and pelvic deformities. It thus offers an opportunity for diagnosing kidney tumors and other space-occupying lesions at a much earlier stage in their development than has hitherto been possible. As noted in the section on the animal experiments, the method must be considered as unproved because of the small amount of material for evaluation thus far available. It is felt that the best clinical application at the present is in cases of unexplained unilateral hematuria or in any case in which a renal tumor is suspected and pyelography gives negative results. Our experience, though meager, appears to show that there are no contraindications to the procedure other than those applying to intravenous urography in general.

CONCLUSIONS

1. A method is described by means of which the value of nephrography may be determined in the experimental animal.
2. Representative cases in which this method has been used are presented.
3. The feasibility of demonstrating masses of non-functioning tissue within the kidney by means of nephrography has been demonstrated.
4. A simple method of nephrography in the human subject, with the aid of a specially developed catheter, is presented, and representative cases are given.

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SUMARIO

Nefrografía: Observaciones Experimentales y Clínicas

Los experimentos en animales y observaciones en sujetos humanos, aquí descritos, indican que la nefrografía ofrece posibilidades bien definidas de constituir un método útil para revelar las lesiones circunscritas del parénquima renal antes de alcanzar tamaño suficiente para ocasionar deformidades de los cálices y pelvis, ofreciendo asi la oportunidad de diagnosticar nefromas y otras lesiones invasoras mucho antes de lo que ha sido posible hasta ahora.

En los sujetos humanos se llevó a cabo el procedimiento con la ayuda de un catéter oclusivo especial provisto de una delgada vaina de latex. El catéter es introducido de modo que su extremo quede en la porción abdominal del uréter, distendiéndose entonces la vaina de latex con 0.5 cc. de skiodán. Después de una espera de 15 ó 20 minutos para dejar formarse retropresión urinaria adecuada en la pelvis renal y porción superior del uréter, se inyectan endovenosamente 20 cc. diodrasto o neoyopax al 35 por ciento, y se toman radiografías a plazos de cinco, diez y veinte minutos. Según parece, no hay más contraindicaciones a este procedimiento que las aplicables en general a la urografía intravenosa.

Debido al poco material disponible, hay que considerar la técnica todavía como experimental. Parece que la mejor aplicación clínica por ahora es en casos de hematuria unilateral inexplicada y en aquellos en que se sospecha tumor renal y la pielografía resulta negativa.

Roentgen Examination of the Hip in Legg-Perthes' Disease[1]

ERNEST H. BETTMAN, M.D., and ROBERT S. SIFFERT, M.D.

ALTHOUGH THE pathogenesis of Calvé-Legg-Perthes' disease is still unsolved, the radiographic appearance of the involved femoral capital epiphysis and metaphysis has been rather thoroughly described. The most complete discussion of x-ray changes is that of Brailsford (1), who recognized the disease as being self-limited in nature. The aseptically necrotic bone of the femoral capital epiphysis is soon invaded by granulation tissue. During this stage of creeping substitution, where the dead bone is replaced by viable bone, the areas involved become relatively porotic, due to the marked vascularity and the abundance of granulation tissue. The epiphysis, therefore, is relatively plastic and vulnerable to the deforming effects of pressure. In addition, the trabeculae of necrotic bone have been shown to be more friable than those of living bone (2). Although the treatment has been modified by many, the principal concept has been a non-weight-bearing regime to avoid pressure on the epiphysis. This is variously accomplished by traction, Perthes' sling, plaster, caliper brace, bed-rest, etc., until x-ray examination reveals adequate reconstitution of the femoral head.

According to Brailsford, the plastic phase extends from the third month of the disease until complete consolidation has been accomplished, at about the end of the fourth year after the onset of the process. The roentgen changes during this period are consistent with the pathological findings of replacement of necrotic bone, and are characterized principally by density, fragmentation, porosis, and reconstitution. It is clear to see, then, that practically the entire natural history of the disease is represented by the plastic phase, and that the outstanding criteria of its progress are the roentgen findings.

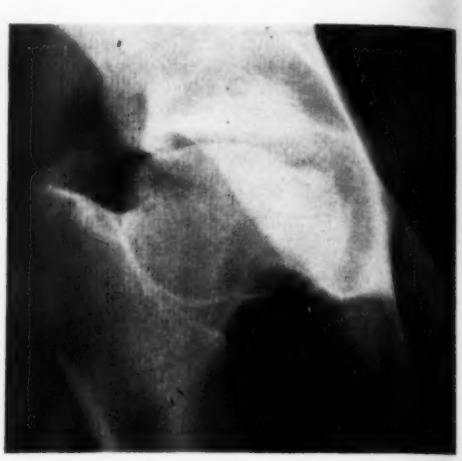

Fig. 1. Roentgenogram of the left hip in a 16-year-old male who had Perthes' disease at the age of eight. At that time he was treated for six weeks in plaster and for four weeks on crutches, following which he was permitted unlimited weight-bearing. The roentgenogram demonstrates the severe degree of deformity that results from weight-bearing during the plastic phase of the disease.

It is the purpose of this report to emphasize the need for more careful evaluation of roentgenograms of the hip during the course of this disease, in order to avoid premature arthritic changes in early adult life (Fig. 1). It is not a lack of knowledge or difficulty in recognition of the early changes of Perthes' disease that leads to a misinterpretation of the roentgenograms. It is, rather, an incomplete roentgen examination that veils the characteristic findings. The routine examination of the hip consists of an anteroposterior view and a lateral view. The latter is frequently unsatisfactory, or even impossible, due to the technical difficulties incident to the marked limitation of motion, especially during the early phases of the disease. It can be clearly shown that unless the femoral capital epiphysis is viewed in many projections, large defects of the femoral head and metaphysis can be overlooked.

[1] From the Blythedale Home, Valhalla, N. Y., and the Orthopedic Service of Mount Sinai Hospital, New York, N. Y. Services of Robert K. Lippmann, M.D. Accepted for publication in September 1948.

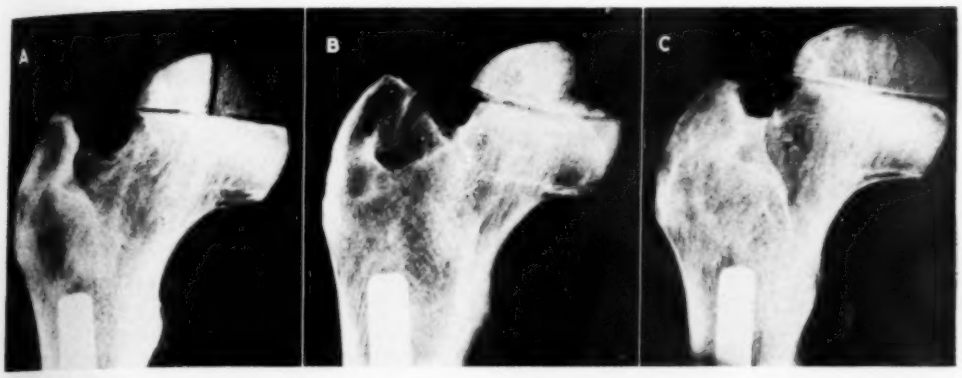

Fig. 2. Roentgenograms of an adult femur fashioned so that the upper hemisphere of the head represents the femoral capital epiphysis. The hemisphere was sectioned in quadrants, and the anteromedial quadrant was removed. A. Plane I, anteroposterior view, shows that, although the contour of the epiphysis is apparently normal, the absence of the anteromedial quadrant is discernible by a difference in density between the medial and lateral halves. B. Plane II, internal rotation, demonstrates the defect caused by the removal of the quadrant, seen in profile. C. Plane III, external rotation, shows complete veiling of the absence of the quadrant because of the overlapping of normal bone. This clearly demonstrates that a defect as large as one-fourth of the capital epiphysis might easily be overlooked on certain projections, whereas it is clearly seen on other projections. Exact anatomical localization of the defect is obvious, since it occupies a medial position on view A (anteroposterior), and is seen on profile medially on internal rotation (view B). If (B) and (C) were reversed so that the defect were seen on profile in external rotation, the absent quadrant would be in the posteromedial position. This principle can be applied to defects in any portion of the epiphysis.

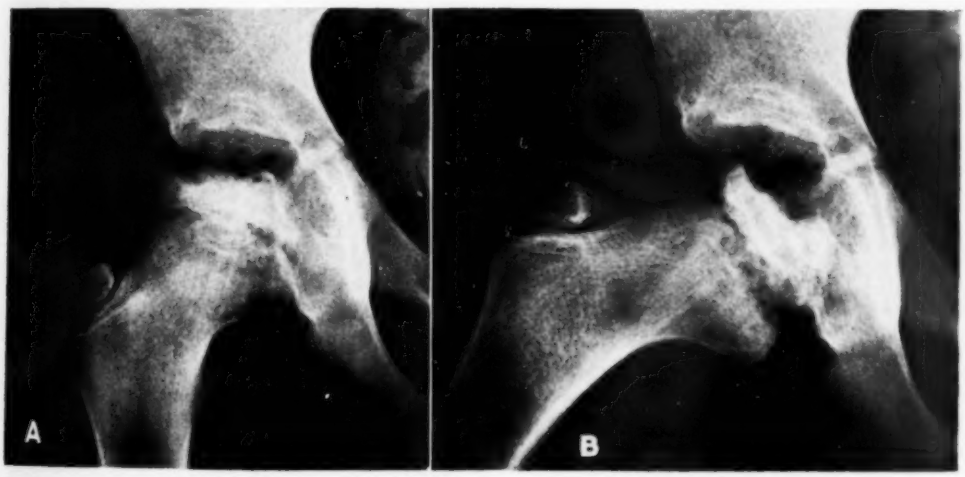

Fig. 3. Roentgenograms of the hip of a patient with Perthes' disease, demonstrating flattening with slight mottling on the anteroposterior view (A), with a large defect in the epiphysis seen clearly only on internal rotation (B).

The upper portion of an adult femoral head was sectioned into quadrants and roentgenograms were obtained in various projections. It was designed to represent the relative size and location of the femoral capital epiphysis. With a complete quadrant removed, it was often difficult or impossible to determine its absence in certain views, depending upon which quadrant was removed, due to overlapping of normal bone. Its absence became evident only when internal rotation and external rotation views were examined and compared to the routine projections (Fig. 2).

This report is based upon x-ray examination of over 40 cases of Legg-Perthes'

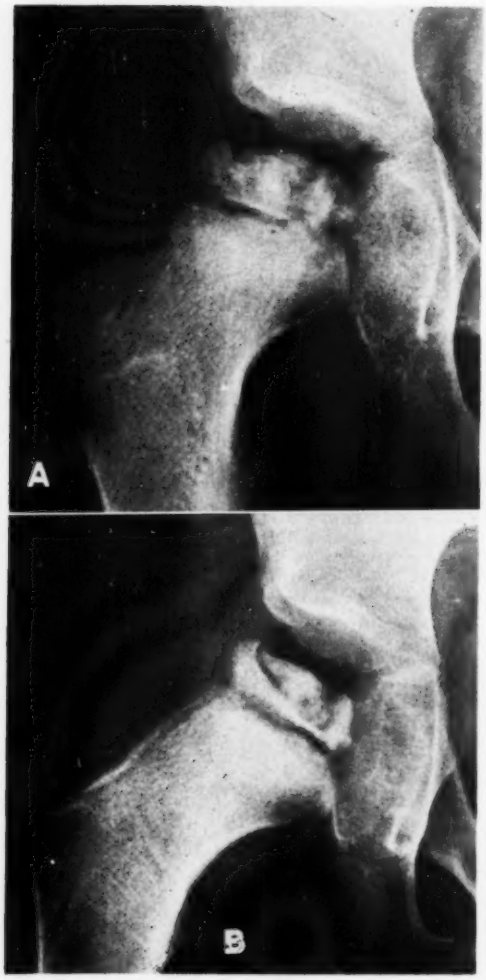

Fig. 4. Roentgenograms of the hip of a patient with Perthes' disease demonstrating diffuse mottling of the epiphysis on the routine anteroposterior view (A), with the characteristic lesion ("sequestrum type") clearly seen only on internal rotation (B).

disease. All but a few were studied by means of multiple views in an attempt to standardize a technic that would simply and adequately reveal changes in all parts of the femoral capital epiphysis. It was soon found that, not only did a better picture of the architectural changes in the head present itself, but lesions could be identified that were not suspected on routine views. By comparing similar views during the course of the disease, individual lesions could easily be anatomically localized and followed for their entire life history.

For routine examination of the hip a standard "four-plane" study has been adopted. This includes an anteroposterior projection of the entire pelvis, including both hips simultaneously in the positions:

Plane I: Neutral
Plane II: Internal rotation
Plane III: External rotation
Plane IV: Lateral

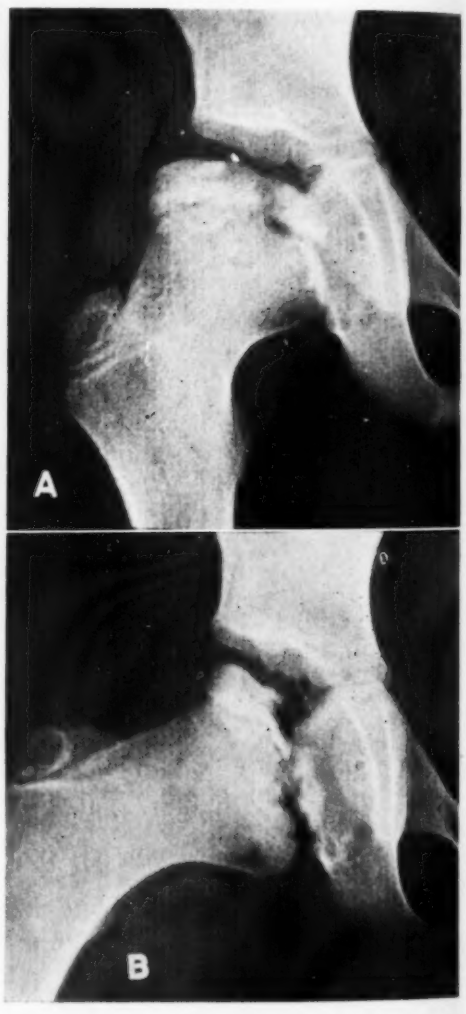

Fig. 5. Roentgenograms of the hip of a patient with Perthes' disease: mottling and irregularity of the head seen on the anteroposterior view (A), with a definite defect seen clearly only on internal rotation (B).

A fifth view, abduction in internal rotation, may occasionally be taken as a further aid in localizing or demonstrating lesions of the posterior aspect of the head. Stereoscopic examination may be of value in confusing cases with multiple lesions, where more detailed information is desired. Routine stereoscopic views have the disadvantage of difficulty in comparing serial films. Once the principal lesion or lesions have been localized and identified most clearly in a particular view, that view alone may be taken for routine check-up. The four-plane views may be included for interval examination only, to study less marked changes or the appearance of newly involved areas in other parts of the head and metaphysis.

Since the four-plane routine involves the principle of rotation of the femoral capital epiphysis about a central axis, in addition to a lateral projection, any one area will be thrice visualized; namely, in its neutral position (Plane I, anteroposterior), internally rotated (Plane II), and externally rotated (Plane III) (Fig. 2). Not only does this permit examination of areas that might be overlooked because of overlapping of normal bone in any one projection, but it often permits exact anatomical localization of lesions in the epiphysis, depending upon their appearance in the various views (Figs. 3, 4, 5). This method can be of use in other types of hip disease where serial check-ups of localized lesions are necessary.

SUMMARY

Since the diagnosis of Legg-Perthes' disease and the clinical management of the case depend almost completely upon the appearance and the progress of x-ray changes, it is felt that more detailed and complete roentgenologic studies are indicated. It can be clearly demonstrated that large defects in the femoral capital epiphysis can be overlooked on routine views, and thereby jeopardize the possibility of a well functioning hip by decisions for too early weight-bearing. It is suggested that more careful roentgen examination be performed routinely in cases of Legg-Perthes' disease, preferably employing the "four-plane" method outlined herein.

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SUMARIO

Examen Roentgenológico de la Cadera en la Enfermedad de Legg-Perthes

Dado que el diagnóstico de la enfermedad de Legg-Perthes y la atención clínica del caso se basan casi completamente en el aspecto y la evolución de las alteraciones roentgenológicas, parece que se hallan indicados estudios radiológicos más detallados y completos.

En las vistas anteroposteriores y laterales corrientes pueden pasarse por alto grandes deformaciones de las epífisis de la cabeza del fémur, por lo cual se sugiere la adopción de una técnica de examen en "cuatro planos":

Plano I: Neutral
Plano II: Rotación interna
Plano III: Rotación externa
Plano IV: Lateral

Si se necesita para más ayuda en la localización o demostración de lesiones de la cara posterior de la cabeza, puede tomarse otra vista, la V, en abducción en rotación interna.

Sodium Tetraiodophthalicfluorescein for Intravenous Cholecystography[1]

MARCUS J. SMITH, M.D., and GEORGE E. MOORE, M.D.

A NEW DRUG, sodium tetraiodophthalicfluorescein,[2] has been utilized for intravenous cholecystography in 25 patients, showing certain advantages which prompt this report.

Fluorescein and its derivatives were utilized at the University of Minnesota Hospitals by Moore (1) in attempts to produce fluorescence in malignant tissue. Introduction of iodine into the phthalic portion of fluorescein produced a drug concentrated by the gallbladder and visible roentgenographically.

The chemistry of this compound has been reviewed in a previous publication. Briefly, fluorescein is closely related to phenolphthalein, and, by iodinating the phthalic ring, compounds are obtained that retain their fluorescence, have great solubility, and are low in toxicity as compared to fluorescein derivatives obtained by iodination of the resorcinol fraction. Of the compounds produced, the tetraiodophthalic compound has the greatest advantage in these respects. This compound contains 55.2 per cent iodine by weight, and has been made up in a 10 per cent solution in distilled water. The average adult dose has been about 2 to 3 gm., although quantities up to 10 gm. have been given without deleterious effects. After preliminary trials with slow administration, the final method worked out consisted of rapid intravenous injection (two to three minutes) of 20 c.c., or more, of the drug (2 gm. or more), though as little as 1.6 gm. produced good gallbladder shadows in two cases. A dosage schedule of 40 mg. per kilogram of body weight is satisfactory. The only preparation for the procedure was the omission of breakfast in the morning. The patient then was sent to the x-ray department, where the drug was administered, and films of the gallbladder region were obtained two hours later. The usual technics were employed, including a fatty meal and the use of pitressin or cleansing enemas if necessary.

The choice of two hours as optimum for gallbladder concentration was based on subjective study of films obtained on different individuals from five minutes to thirty-six hours after injection (Fig. 1), and upon studies of radioactive diiodofluorescein (I^{131}), which showed rapid increase in counts over the gallbladder region, as recorded by a Geiger-Müller counter, forty-five minutes after injection.

RESULTS

Good or excellent visualization was obtained in 13 of the 25 patients studied (50 per cent), poor visualization in 6 (25 per cent), and non-visualization in 6 (25 per cent). Causes of non-visualization were: insufficient dye (2 cases), absence of gallbladder (1 case), biliary atresia (1 case), and disease of the gallbladder (2 cases).

In 7 of these patients Priodax studies were done. Gallbladder densities were substantially equal. Two cases showed non-visualization with both methods. Two gallbladders were visualized with fluorescein and not with Priodax, failure with the oral dye being due to pyloric obstruction. In 2 cases a comparison with oral tetraiodophenolphthalein studies was obtained; the gallbladder shadows were about similar in density (Fig. 2).

TOXICITY

All patients were tinted a light pink, the color remaining for about twelve to eighteen hours. The original compound used caused

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[1] From the Departments of Radiology and Surgery of the University of Minnesota Hospitals, Minneapolis, Minn. Accepted for publication in September 1948.
[2] Supplied in part by Abbott Laboratories, North Chicago, Ill.

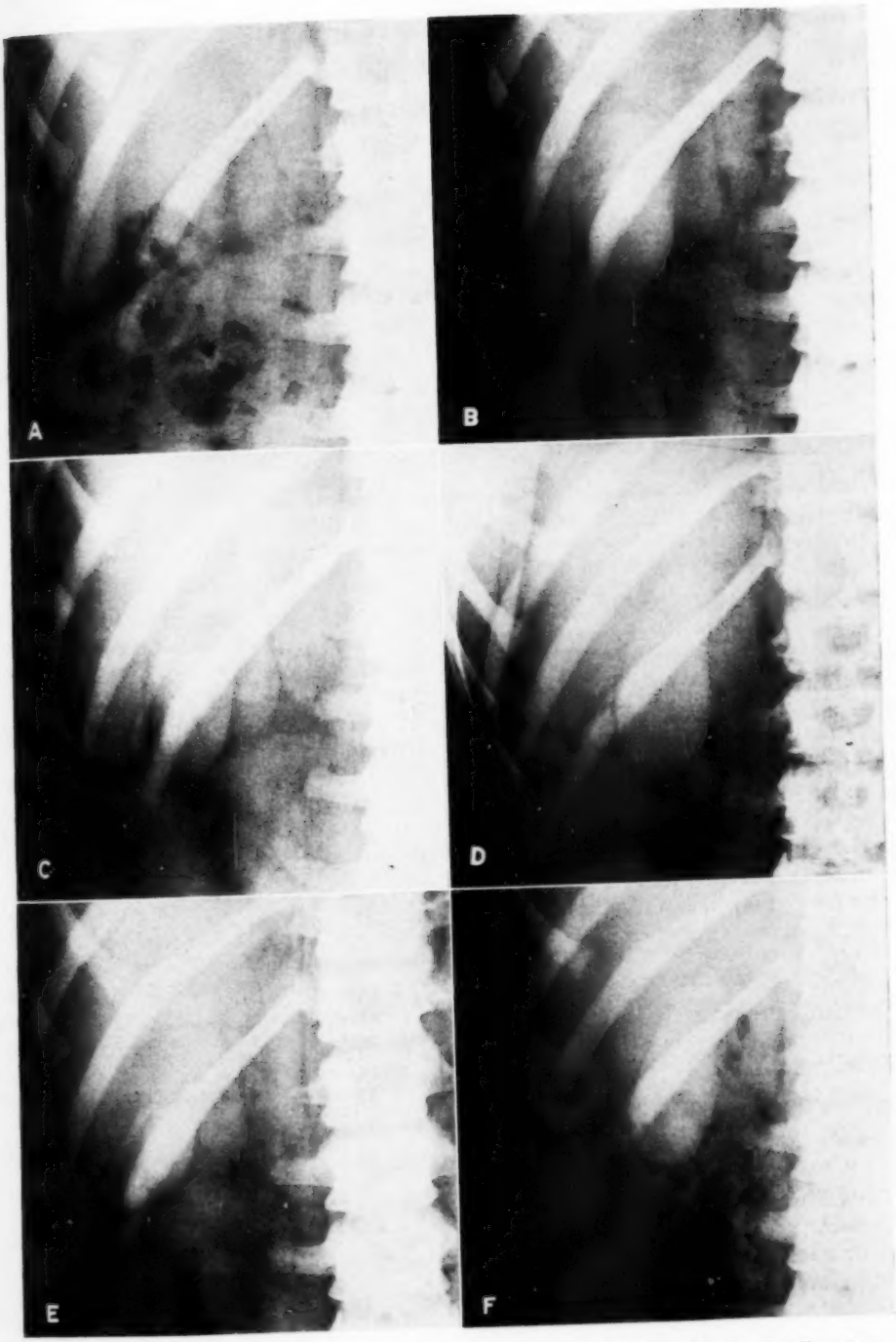

Fig. 1. A. Gallbladder shadow thirty minutes after intravenous injection of 5 gm. of sodium tetraiodophthalicfluorescein. B. After one hour. C. After one and one-half hours. D. After two hours. E. After four hours. F. After eight hours.

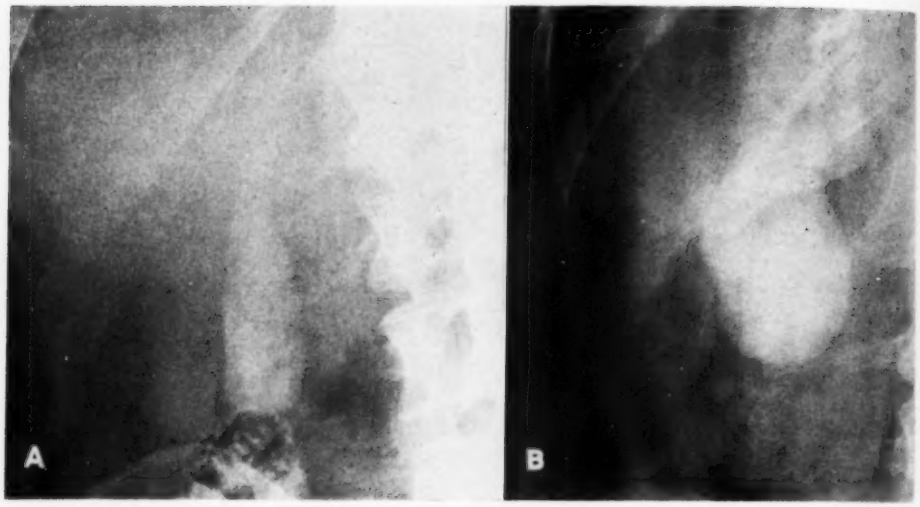

Fig. 2. A. Cholecystogram obtained with oral administration of tetraiodophenolphthalein in 1943 (single dose). B. Gallbladder shadow in same patient two and one-half hours after rapid intravenous injection of 2 gm. of sodium tetraiodophthalicfluorescein in 1948.

nausea and severe intestinal contractions, but with the purified samples later employed, nausea occurred in only 2 patients. No vomiting or diarrhea was produced. Three patients who received large amounts of dye (9–10 gm.) over a long period had acute thrombophlebitis of the veins proximal to the injection site. After a change in the *p*H of the solution, this complication was not experienced. In 2 patients there was infiltration of the solution into the subcutaneous tissues, but only transient local pain and redness developed.

CONCLUSION

Sodium tetraiodophthalicfluorescein in doses of approximately 40 mg. per kilogram administered by rapid intravenous injection produces contrast visualization of the gallbladder in one or more hours. The optimum time of visualization is between two and three hours. Toxicity has been minimal; all patients have been tinted a light flesh-pink color for eighteen to twenty-four hours.

Our experience as yet is insufficient to recommend general use of this compound. The results however, are sufficiently promising to justify further investigation.

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SUMARIO

La Tetrayodoftalicofluoresceína Sódica para la Colecistografía Intravenosa

La tetrayodoftalicofluoresceína sódica a dosis de unos 40 mg. por kilogramo de peso vivo, administrada en rápida inyección endovenosa, produce en una o más horas visualización de contraste de la vesícula biliar. El tiempo óptimo de visualización es entre dos y tres horas, La toxicidad ha sido mínima; todos los enfermos han mostrado un tinte rosado-cárneo claro por espacio de dieciocho a veinticuatro horas.

La experiencia con este compuesto es insuficiente para recomendarlo para empleo general, pero los resultados, por lo prometedores, justifican nuevas investigaciones.

Cholecystocolic Fistula[1]

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THE RADIOGRAPHIC demonstration of cholecystocolic fistula is uncommon. Peter Paw and Diemer Broeck (3) in 1514 described two cases of congenital abnormal insertions of the gallbladder into the colon. Theirs was probably the earliest description of cholecystocolic fistula. The operative discovery of cholecystocolic fistula became more frequent toward the end of the nineteenth century. Through 1885 Murchison (10) was able to find the records of 9 cases, in 6 of which there was a carcinoma of the gallbladder. Courvoisier (3), in a survey of the world literature up to 1890, found 490 cases of internal and external biliary fistulae, of which 39 were cholecystocolic. In 1925 Judd and Burden (6) reported 25 surgically proved cholecystocolic fistulae in a series of 153 cases of internal biliary fistulae. Bernhard (1) analyzed the results of 6,254 operations on the gallbladder, and found 109 internal biliary fistulae of which 36 were between the gallbladder and the colon.

ETIOLOGY

The majority of cases of cholecystocolic fistulae are associated with cholelithiasis, cholecystocolic adhesions, and ulceration of the gallbladder wall by a gallstone with perforation of the colon. Courvoisier (3) noted stones in the biliary system in 27 of his 39 collected cases of cholecystocolic fistula and observed that the stones may have passed through the fistula and into the large bowel in the remaining 12 cases. Gallstones in the gallbladder or bile ducts were found in 121 of the 153 cases of internal biliary fistulae reported by Judd and Burden (6), and in 92 of the 109 cases of internal biliary fistulae reported by Bernhard (1). It would thus seem that the most common etiology for this type of fistula is infection, with stones, and that primary carcinoma of the gallbladder is an uncommon producing factor.

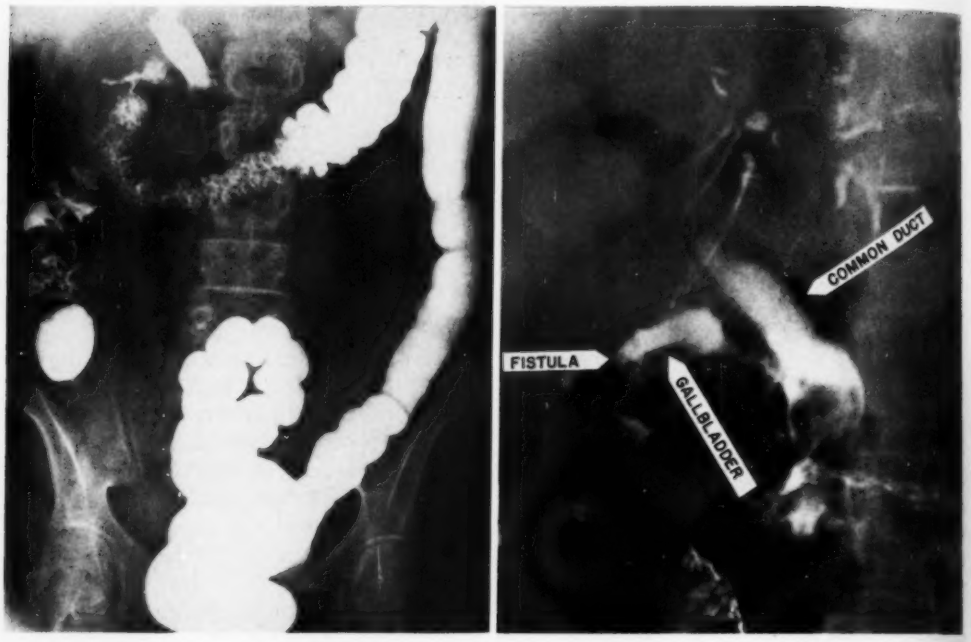
DIAGNOSIS

The clinical diagnosis of cholecystocolic fistula is rarely made. Prior to the advent of radiology, its discovery was usually at the operating table or at autopsy. Recently accidental radiologic demonstration, by barium meal or barium enema, of a fistulous communication between the colon and the gallbladder has permitted the accurate preoperative diagnosis of cholecystocolic fistula in a small number of cases. One of the first cases diagnosed preoperatively was included in a paper by Judd and Burden (6), but no details of the case history were given, nor did reproductions of roentgenograms accompany the report. Since that time, 12 cases of cholecystocolic fistula demonstrated by barium enema have been reported (2, 4, 5, 6, 8, 11, 14, 15, and 16). Three of the above cases (5, 8, and 11) were examined in addition with the aid of the barium meal; in 1 of these (11) a fistula was demonstrated but in the other 2 no fistulous tract was observed. Stevenson and Sherwood (15) emphasize the importance of sudden relief of right upper quadrant pain as evidence of the probable time of establishment of the internal biliary fistula. In all of the reported cases there was a history of many years duration. In 3 patients a severe attack of right upper quadrant pain preceded the investigation which revealed the fistula. Air was demonstrated in the biliary system in two cases (2, 15).

OPERATIVE FINDINGS AND PROGNOSIS

At operation the gallbladder is generally small and buried in a mass of dense adhe-

[1] From the Department of Radiology, Mount Sinai Hospital, Service of Dr. Marcy L. Sussman. Accepted for publication in November 1948.



Figs. 1 and 2. Case I. Barium enema study revealing a free flow of barium from the rectum to the hepatic flexure. At the latter point the barium passes through a fistulous tract into a contracted gallbladder and then into a dilated common duct. There is a filling defect at the termination of the common duct which contained grumous infected material but no calculi. Fig. 2 (right) is a magnification of the fistulous area shown in Fig. 1.

sions. Stones are usually present. The demonstration of the fistulous tract may be extremely difficult and in many cases it cannot be located. The portion of the colon which is involved is invariably the hepatic flexure or the proximal transverse segment. Cholangitis of any severity is not a common finding, and is not reported with greater frequency following the demonstration of the fistulous tract by means of the barium enema.

No statistics are available to indicate in what manner the presence of a cholecystocolic fistula alters the prognosis of a pre-existing chronic cholecystitis. Judd and Burden (6) reported 16 deaths in their series of 153 internal biliary fistulae of all types, a mortality of 10.5 per cent. The mortality rate in the same institution, at the same time, for uncomplicated cholecystectomies was about 1 per cent. Bernhard (1) reported 9 deaths in his series of 109 cases of internal biliary fistulae of all types, a mortality rate of 8.3 per cent.

Surgery was refused by 7 patients in the series in whom the cholecystocolic fistula was demonstrated by means of the barium enema. In 5 of these patients there was considerable gradual spontaneous improvement or complete relief of symptoms. In 2 cases no follow-up was available. It would seem that surgery is not essential once the condition has been diagnosed.

CASE REPORTS

CASE 1: B. L., a 60-year-old married female, first experienced pain in the right upper quadrant radiating to the right shoulder, in 1932. The gallbladder was not demonstrable by oral cholecystography. In 1938, after several attacks of pain, operation was recommended but refused. The patient was well until 1946, when she experienced another severe attack of upper abdominal pain requiring opiates for relief. Many similar attacks followed. Seven weeks prior to hospital admission she had passed black stools for one week, at the end of which time she fainted. Two transfusions were administered at home, and after another week the stools were guaiac-negative. A presumptive diagnosis of duodenal ulcer was made, but a gastrointestinal series performed elsewhere revealed

no evidence of any abnormality. A barium enema examination was reported as showing a polyp in the proximal transverse colon.

Physical examination at our institution, four weeks after the hemorrhage, showed the patient to be fairly well developed, well nourished, and not jaundiced. The findings were essentially negative, except for moderate tenderness in the right upper quadrant. Laboratory findings were: hemoglobin 80 per cent; white cells 14,000; urine negative; sedimentation rate moderately increased (30).

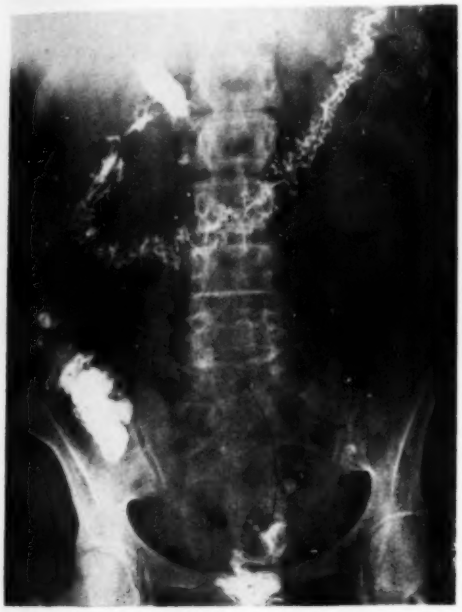


Fig. 3. Case I. Post-evacuation film showing barium still remaining within the shrunken gallbladder and dilated common duct.

A preliminary film of the abdomen showed air in the biliary system. A repeat barium enema examination revealed a free flow of barium from the rectum to the hepatic flexure. At that point the barium passed through a fistulous tract into a contracted gallbladder and then into a dilated common duct. There was a filling defect at the termination of the common duct which was interpreted as incomplete filling, or possibly a stone. Several biliary radicles were visualized (Figs. 1 and 2). The polyp previously described was not observed. No further abnormality was noted within the large bowel. The evacuation film (Fig. 3) revealed barium still remaining within the gallbladder and common duct. A diagnosis of cholecystocolic fistula was made, and two months later the patient was explored.

Operative Findings: When the peritoneal cavity was entered, the hepatic flexure of the colon was found to be agglutinated to the fundus of the gallbladder. At this point there was a direct fistula measuring about 3/8 inch in diameter. The common duct and cystic duct were widely dilated. Both the common duct and the gallbladder contained grumous infected material but no calculi. The fistula was disconnected and the opening in the colon repaired. The patient made an uneventful recovery.

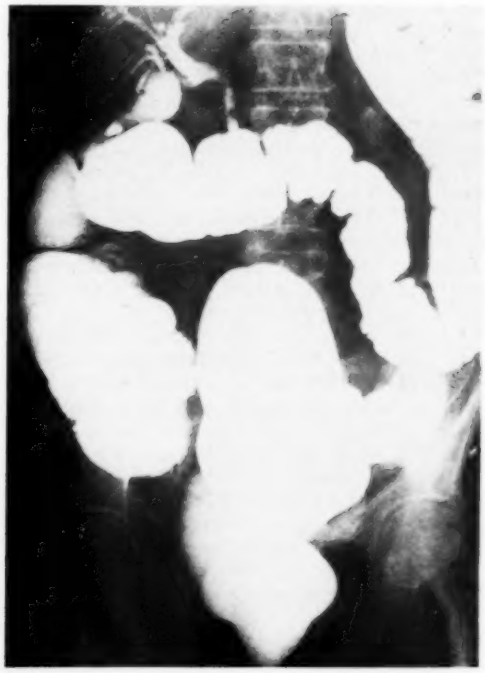


Fig. 4. Case II. Cholecystocolic fistula with visualization of gallbladder, common duct, and biliary radicles. No other abnormality in the large bowel.

The foregoing case was of unusual interest because of the melena. In the original report there was a comment suggesting the presence of air in the biliary tract; however, a polyp was described in the transverse colon. It is possible that the polyp was a stone that had passed into the large bowel. It is also of interest that the patient's complaints were minimal at the time of the barium enema and during the two-month waiting period prior to operation she was completely asymptomatic.

CASE 2: L. L., a 64-year-old white female, was admitted to Mount Sinai Hospital on Nov. 20, 1947, because of recurrent epigastric pain and fever of four weeks duration. The first attack began with severe non-radiating epigastric pain accompanied by nausea

but no vomiting. The temperature at that time was 100.4°. About ten hours after the onset both the pain and the fever disappeared spontaneously. Following the initial attack, similar episodes occurred every two to four days until admission. On one occasion transient jaundice was observed. The past history was essentially negative.

Physical examination revealed a round cystic mass beneath the liver edge, the size of a golf ball. The remainder of the examination was negative. Laboratory findings were not significant. The clinical impression was acute cholecystitis with cholelithiasis. A flat plate of the abdomen revealed the biliary tract outlined by air.

A barium enema examination was performed six days later and revealed a fistulous communication into the gallbladder (Fig. 4). The entire gallbladder, common duct, and hepatic duct were visualized. There were no ill effects following the barium enema. No barium meal examination was performed.

Operative Findings: The hepatic flexure of the colon was found adherent to the ampulla of the diseased gallbladder. At this site was a fistula 3/8 inch in diameter. The colon was dissected free and the gallbladder, full of stones, was removed from below upward. Recovery was uneventful.

DISCUSSION

Cholecystocolic fistula is an infrequent complication of gallbladder disease. The preoperative diagnosis is rarely made, and the cases are usually found incidentally during a barium enema examination. In the two cases described above the preliminary films revealed air in the biliary system and a barium enema examination established the presence of the fistulous communication between the gallbladder and the colon. There is some controversy as to the danger of cholangitis resulting from a barium enema examination when a cholecystocolic fistula is suspected. This complication did not occur in our cases nor in the cases described in the literature. Operation is not always necessary, as some of the patients have gone along for years without difficulty.

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SUMARIO

Fístula Colecistocólica

La fístula colecistocólica representa una infrecuente complicación de las colecistopatías, que rara vez se diagnostica preoperatoriamente. Radiográficamente, suele encontrarse fortuitamente durante los exámenes con enemas de bario.

En los dos casos presentados las radiografías preliminares revelaron aire en el aparato biliar y el estudio con enema de bario estableció la presencia de la comunicación fistulosa entre la vesícula biliar y el colon.

Reina alguna controversia con respecto al peligro de producir colangeítis con el examen con enema de bario cuando se sospecha fístula colecistocólica. Esta complicación no ocurrió en los casos de los AA. ni en los descritos en la literatura.

Roentgen Findings in Acute Friedländer's Pneumonia[1]

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DURING THE PAST ten years a number of cases of acute pneumonia due to Friedl"nder's bacillus (*Klebsiella pneumoniae, B. mucosus capsulatus*) have come to our attention. It appeared to us that the chest roentgenograms of many of these patients differed in some respects from those commonly seen in other types of acute pneumonia. These observations stimulated us to study all of the cases of pneumonia due to Friedländer's bacillus which have been seen at the Cincinnati General Hospital since 1939. The roentgenologic features of this group of cases serve as the basis for this paper.

In a disease which is as fulminating and rapidly progressive as acute Friedländer's pneumonia, any clue toward early accurate diagnosis is, of course, of great importance. Penicillin has proved such a successful agent in treating so many different forms of acute pneumococcal pneumonia that in many institutions accurate and complete bacteriologic studies are often deemed unnecessary. For this reason some cases of pneumonia due to Friedländer's bacillus may be missed. Such errors may lead to improper therapeutic procedures, since this type of pneumonia does not respond to penicillin but may possibly be improved by the use of streptomycin or other newer antibiotics. A roentgenologic approach toward the problem of separating Friedländer's pneumonia from other acute pneumonias may, therefore, be of great assistance to the clinician. A search of the literature reveals a dearth of data relating to this subject; hence we are prompted to report our observations.

MATERIAL

Sixteen cases of acute Friedländer's pneumonia comprise this study. Fifteen of these were from the files of the Cincinnati General Hospital and one case was seen at Fort Thomas (Kentucky) Veterans' Hospital. Fourteen of the patients died, and 13 autopsies were performed. One or more chest roentgenograms were available for study in each case. For purposes of comparison, parallel studies were carried out on films from 58 patients with acute pneumonia due to other causes, of whom 25 were known to have pneumococcal pneumonia with bacteremia. The latter group of 25 was selected because the severity of the disease approximated that of the Friedländer cases.

CLINICAL AND PATHOLOGICAL FINDINGS

The diagnosis of Friedländer's pneumonia is established by the isolation of the causative organism from the sputum, blood stream, pleural fluid, aspirated lung juice, or secretions removed bronchoscopically. All of the cases in the present series were diagnosed by one or more of the above methods. Detection of a few of the characteristic organisms in the sputum alone was not accepted as unequivocal evidence of the disease, inasmuch as healthy individuals are said on occasion to harbor this bacillus in the upper respiratory passages (1, 7).

Friedländer's pneumonia comprises approximately 0.5 per cent of all acute pneumonias. The disease usually affects persons in late middle life. Our patients ranged in age from twenty-two to sixty-four years, with an average age of fifty-two years. Males predominate in most recorded series; 13 of our 16 cases were men (81 per cent).

The patients usually exhibit profound toxemia and run a rapidly progressive course. The onset is commonly abrupt,

[1] From the Departments of Radiology and Medicine, University of Cincinnati College of Medicine. Accepted for publication in November 1948.

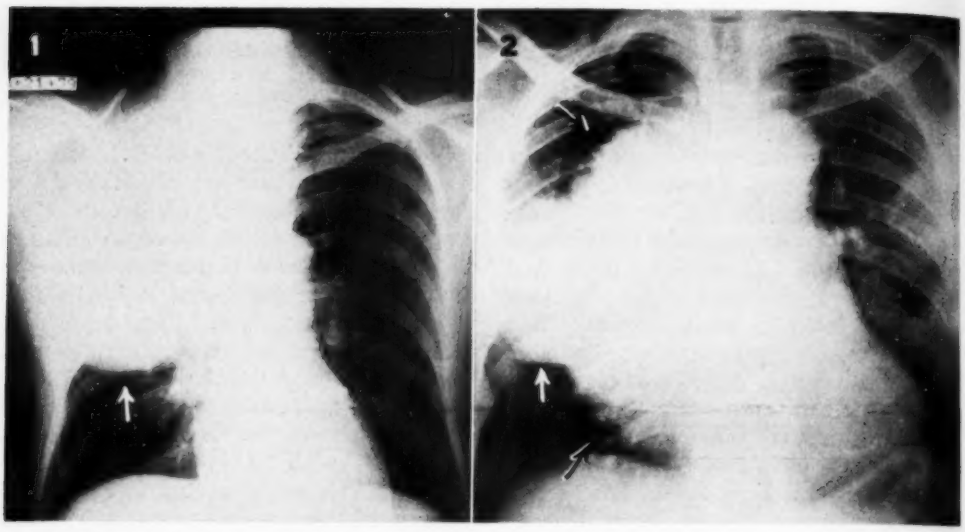

Fig. 1 (A. G.). Right upper lobe Friedländer's pneumonia with bulging minor fissure (arrow).
Fig. 2 (E. R.). Right upper and middle lobe Friedländer's pneumonia with slightly bulging minor fissures (white arrow) and sharp lateral margins (black arrows). Note bronchopneumonia on left. Roentgen findings suggested the correct diagnosis.

with chills, pleuritic pain, productive cough, and hemoptysis. The sputum is often brick-red in color, consisting of a thick, homogeneous, tenacious mixture of blood and mucus, although in some instances it resembles the sputum seen in pneumococcal pneumonia. Dyspnea and cyanosis are common. Physical signs resemble those of pneumococcal pneumonia. The course is commonly fulminating, with profound prostration, and death is the usual outcome. Only a few patients recover, and some of these proceed to a chronic form of the disease. In the present series 14 of the 16 patients died, a mortality of 87 per cent.

At necropsy the involved lobes are usually voluminous, heavy, and firmly consolidated. Areas of softening and abscess formation are frequently found. The pneumonic process is described as lobar, lobular, or confluent lobular (1). In our series the findings of firm solidification and enlargement of the affected lobes were of particular interest. Such consolidation and enlargement were demonstrated to a varying degree in most of our autopsied cases. Abscesses, gross or microscopic, were found in 7. Free pleural fluid was observed in 3 cases, and in only one of these was the amount large. Interlobar fluid was not encountered in any case. The distribution of the lesions was described as lobar or as confluent lobular in every autopsied case.

ROENTGEN FINDINGS

Roentgenograms of the 16 cases of acute Friedländer's pneumonia were reviewed and compared with those from 33 miscellaneous cases of acute pneumonia (many of which were undoubtedly pneumococcal), and 25 additional cases of proved pneumococcal pneumonia with bacteremia. The Friedländer cases will henceforth be referred to as Group 1, the cases of miscellaneous pneumonia as Group 2, and those of pneumococcal pneumonia with bacteremia as Group 3. In many instances only a single film was available; this was particularly true in Groups 1 and 3, since these patients were usually seriously ill and often moribund. In a few cases lateral views and follow-up films were also available.

The following features seemed to us to be worthy of comment:

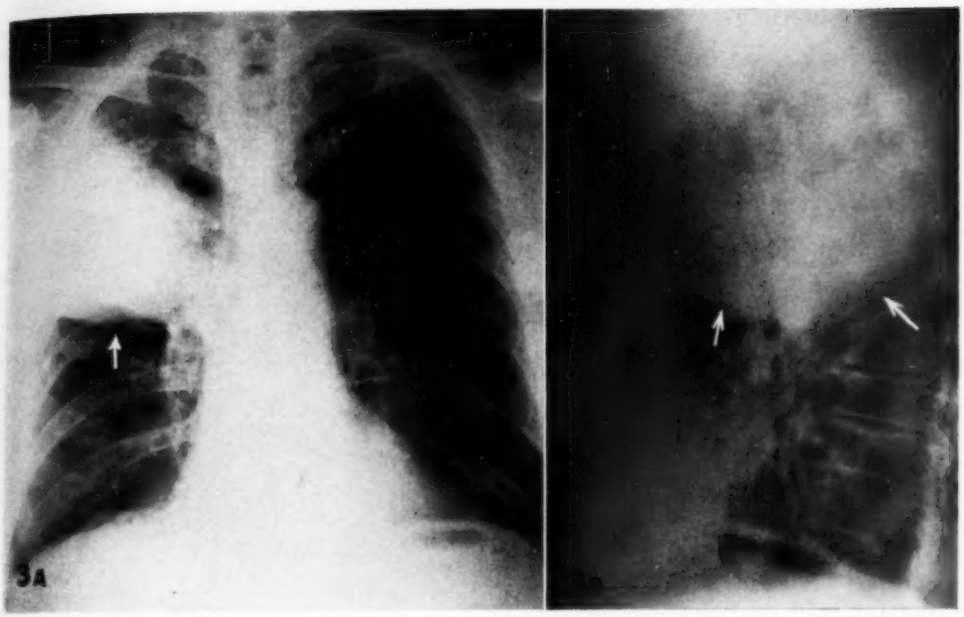

Fig. 3 (W. K.). Right upper lobe Friedländer's pneumonia forty-eight hours after onset. The correct diagnosis was suggested from the roentgen findings. A. Postero-anterior view showing downward bulge of minor fissure (arrow). B. Right lateral view, showing bulging of both major and minor fissures (arrows).

1. *Size of Lobe:* As noted above, the lobes involved by Friedländer's pneumonia are often described by the pathologist as "voluminous" or "bulky." In our earlier experience with this form of pneumonia we encountered several instances of right upper lobe involvement in which a downward bulge of the minor fissure was noted in the frontal view (Fig. 1). Subsequently we encountered 2 additional cases of Friedländer's pneumonia in which the correct diagnosis was suggested from the roentgenogram because of the presence of this finding (Figs. 2 and 3).

Among 5 cases with involvement of the right upper lobe bordering upon the minor fissure, 3 (60 per cent) showed a definite downward bulge of this fissure. In Group 2 (miscellaneous pneumonia) 10 cases showed infiltrate in the right upper lobe abutting upon the minor fissure. Only 1 of these (10 per cent) produced a downward bulge. In Group 3 (pneumococcal pneumonia with bacteremia) the bulge occurred in only 1 of 8 cases (12 per cent).

In a review of the literature we encountered reproductions of roentgenograms from 4 cases of Friedländer's pneumonia in which a bulge of the minor fissure was illustrated (1, 3, 6, 8). Snow (6) and others (1, 8, 9) have also commented upon this finding and noted that it may be mistaken for interlobar fluid. Autopsies performed in the 3 of our cases in Group 1 with roentgenographic bulging of the minor fissure showed no evidence of interlobar fluid or gross abscess formation. The convex shadow seen on the roentgenograms was apparently produced entirely by the swollen pneumonic lobe.

It would be reasonable to expect that involvement of other lobes by Friedländer's pneumonia should similarly affect the adjacent fissures. This proved to be true in 3 of the 4 cases in Group 1 in which lateral views were available (Figs. 3B and 4B). In 2 of the 3 the left upper lobe was affected, and in one of these this lobe was so much enlarged that it produced a slight shift in the midline structures to the right (Fig. 4A), a finding which was confirmed at autopsy. In the third case the right upper

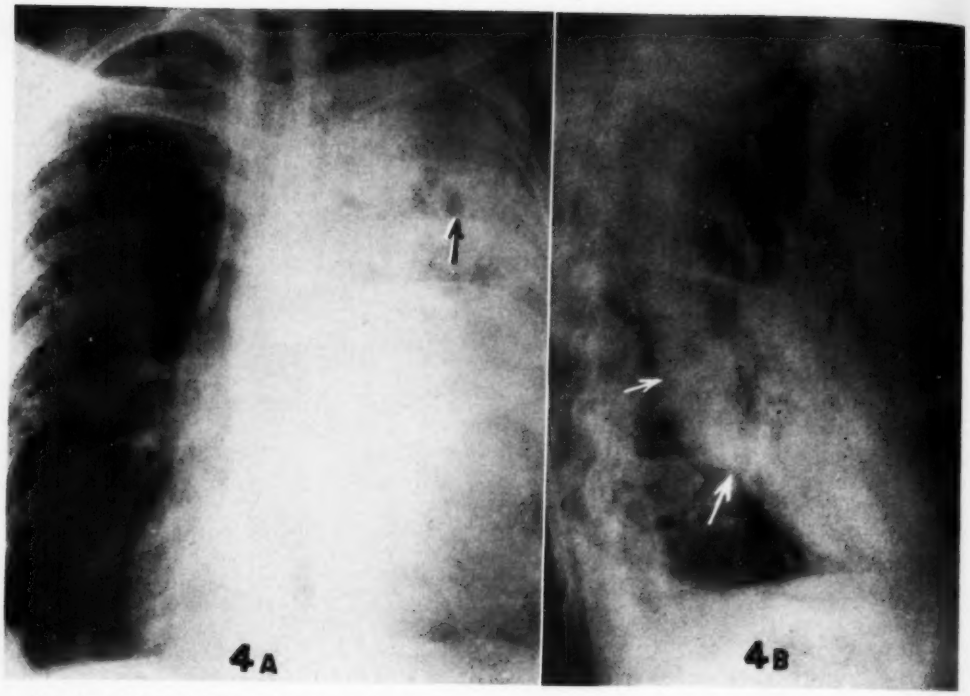

Fig. 4 (B. C.). Friedländer's pneumonia, left upper lobe. A. Postero-anterior view showing displacement of midline structures to right and early break-down within the pneumonic process (arrow). B. Left lateral view showing posterior bulge of major fissure (arrows).

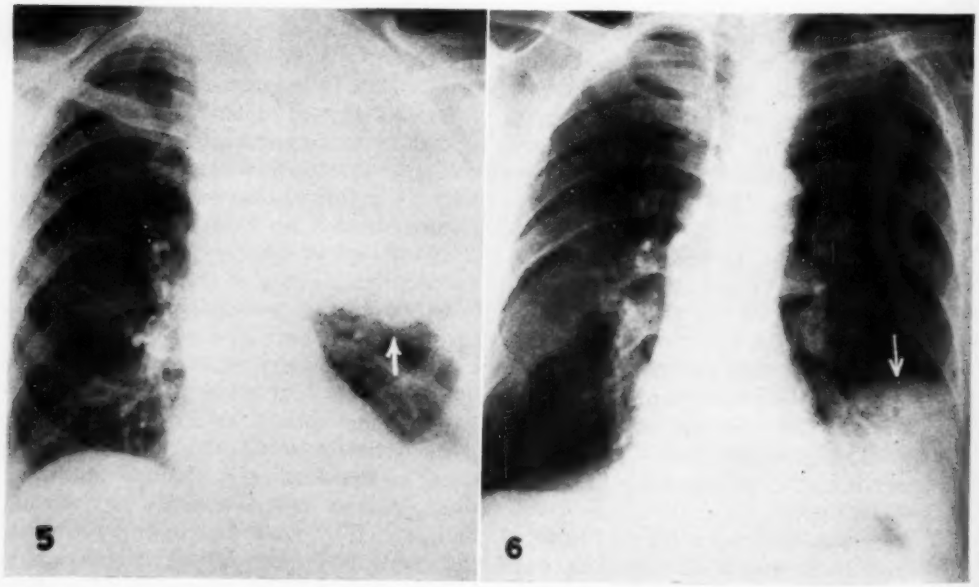

Fig. 5 (E. K.). Left upper lobe Friedländer's pneumonia, showing sharp lower margin arrow).
Fig. 6 (C. G.). Left lower lobe pneumonia forty-eight hours after onset. Sharp upper margin (arrow) suggested Friedländer's pneumonia. Diagnosis confirmed at autopsy. Evidence of old rib resection on right.

lobe was involved and a bulging fissure in both the lateral and postero-anterior views was observed. In none of the 4 cases in Group 2, and in none of the 3 in Group 3 in which lateral views were available, was there evidence of bulging of a fissure.

Therefore, among 8 cases of Friedländer's pneumonia in which, radiologically, the infiltrate lay adjacent to a fissure, 5 (62 per cent) showed bulging of the fissure. In Groups 2 and 3, bulging fissures occurred in 7 per cent and 10 per cent, respectively. Table I summarizes these findings and

TABLE I: INCIDENCE OF LOBAR ENLARGEMENT (BULGING FISSURE) ROENTGENOLOGICALLY DEMONSTRATED

	Number of Cases*	Bulging Fissure
Group 1 (Friedländer's)	8	5 (62%)
Group 2 (Miscellaneous)	14	1 (7%)
Group 3 (Pneumococcal)	11	1 (9%)

* All cases in which the infiltrate failed to extend to a visible fissure are excluded.

confirms Snow's statement that occasionally in pneumococcal pneumonia and frequently in Friedländer's pneumonia the fissures appear to bulge.

2. *Margins of the Pneumonic Infiltrate:* In a number of the cases of Friedländer's pneumonia it was noted that the advancing border of the pneumonic process, although not in contact with the pleural surface or interlobar fissure, was unusually sharp and distinct (Fig. 2). In two instances (Figs. 6 and 7) the presence of this finding was helpful in leading to the establishment of the diagnosis of Friedländer's pneumonia. This observation suggested a segmental distribution of the pulmonary consolidation, but lateral views were not available to clarify this point.

Table II shows the incidence of this finding in the three groups and would appear to indicate its importance in the diagnosis of Friedländer's pneumonia. Although it sometimes occurs in other types of pneumonia, the appearance of a sharply defined advancing border of the pneumonic process should lead one to suspect Friedländer's infection.

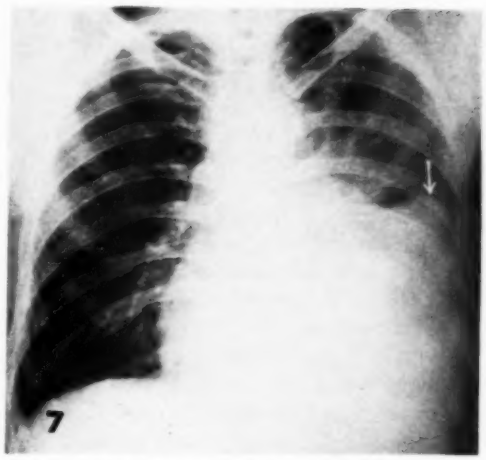

Fig. 7 (O. M.). Friedländer's pneumonia, left upper and lower lobes. Note sharp upper border of infiltrate (arrow).

TABLE II: INCIDENCE OF SHARPLY DEFINED ADVANCING BORDER OF PNEUMONIC DENSITY ON ROENTGENOGRAMS

	Number of Cases*	Sharp Margin
Group 1 (Friedländer's)	14	9 (64%)
Group 2 (Miscellaneous)	30	3 (10%)
Group 3 (Pneumococcal)	17	4 (23%)

* All cases showing *complete* consolidation of one or more lobes are excluded.

3. *Abscess Formation:* Abscess formation is said to occur frequently (2, 8) and early (5) in Friedländer's pneumonia. Kornblum (5) described thin-walled cavities which he believed were roentgenologically diagnostic of this disease.

Abscesses were demonstrated on the roentgenograms in 5 cases in Group 1 (Fig. 4) and in none of the cases in Groups 2 and 3. In 2 of the 5 cases with abscess formation, the cavities were of the thin-walled type described by Kornblum. It is our belief that the early appearance of rarefaction within an area of acute lobar pneumonia should suggest the possibility of Friedländer's infection.

4. *Type of Pneumonia:* Kornblum described four roentgen stages of Friedländer's pneumonia: bronchopneumonia; pseudo-lobar pneumonia; abscess formation; fibrosis (chronic). He stated that the bronchopneumonia rapidly coalesced

to form a pseudo-lobar pneumonia, and the first stage was therefore very brief and seldom detected roentgenologically.

Bullowa *et al.* (1) obtained films on 6 patients within twenty-four hours of onset and only 1 showed a mottled bronchopneumonic infiltrate. Solomon (8) found only 1 instance of bronchopneumonia in 17 cases.

A *pure* bronchopneumonic form was not encountered in our series, despite the fact that roentgenograms were made within forty-eight hours of onset in 4 cases. In 9 of our cases the earliest film showed practically complete involvement of one or more lobes. Although bronchopneumonia was not encountered alone, it was found in association with a lobar type of infiltrate in 6 cases (37 per cent) (Fig. 2). In Group 2 this appearance was noted in 3 cases (9 per cent), and in Group 3 in 4 cases (16 per cent).

5. *Density:* The infiltrate in acute Friedländer's pneumonia has been described roentgenologically as being unusually dense (1, 6, 9). Attention was directed to this quality in our own material, the density of the pulmonary infiltrate being compared with that of the heart shadow. In Group 1 the density of the pneumonic shadow was equal to or greater than that of the heart in all cases. In Group 2 the pneumonic density was less than that of the heart in 10 (30 per cent) and equal or greater in 23 (70 per cent). In Group 3 the corresponding figures were 3 (12 per cent) and 22 (88 per cent).

It is apparent that, while Friedländer's pneumonia almost always produces a relatively dense shadow, other types of pneumonia frequently cast shadows of similar density. The dense pneumonic shadow is therefore of little differential value.

DISCUSSION

It is not our belief that the roentgenologic findings in Friendländer's pneumonia are in themselves pathognomonic. However, the observation of bulging fissures, of sharp margins of the advancing border of the pneumonic infiltrate, and of early abscess formation have enabled us in a number of instances to suggest the correct diagnosis from the roentgenogram alone. A lateral view of the chest should be taken whenever possible to enhance the demonstration of these findings.

Acute pneumonia of varied etiologic nature, encapsulated pleural fluid, pulmonary infarct, tumor,[2] and aneurysm may occasionally produce identical roentgen appearances. Final differentiation must depend on appropriate clinical and bacterial studies.

SUMMARY

Roentgenograms of 16 cases of acute Friedländer's pneumonia were reviewed and compared with those of 33 miscellaneous cases of acute pneumonia and 25 cases of pneumococcal pneumonia with bacteremia.

The size of the affected lobe, the appearance of the margins of the pneumonic infiltrate, the occurrence of abscess formation, the presence of bronchopneumonia, and the radiopacity of the pneumonic shadow were recorded and comparison was made among the three groups of cases.

Bulging of a fissure, sharp advancing borders of the infiltrate, and abscess formation were found to occur in acute Friedländer's pneumonia with considerably greater frequency than in other types of pneumonia. A purely bronchopneumonic form of Friedländer's pneumonia was not encountered in this series. The pneumonic infiltrate in the Friedländer's group was relatively radiopaque, but shadows of similar density were commonly found in other types of pneumonia.

While the roentgenologic findings in Friedländer's pneumonia are not pathognomonic, in many instances it is possible to suggest the correct diagnosis from the roentgenogram.

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[2] In one of our cases a satisfactory history was not obtainable and a mistaken diagnosis of tumor was made.

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SUMARIO

Hallazgos Roentgenológicos en la Neumonía Aguda de Friedländer

Las radiografías de 16 casos de neumonía aguda de Friedländer fueron comparadas con las de 33 casos mixtos de neumonía aguda y de 25 casos de neumonía neumocócica con bacteriemia.

Anotados el tamaño del lóbulo afectado, el aspecto de los bordes del infiltrado neumónico, la ocurrencia de abscesos, la presencia de bronconeumonía y la radioopacidad de la imagen neumónica, hiciéronse comparaciones entre los tres grupos de casos.

En la neumonía de Friedländer encontráronse con mucha mayor frecuencia que en otras formas de neumonía abultamiento de una fisura, bordes bien deslindados y en avance del infiltrado y formación de abscesos. Siempre que sea posible se tomará una vista lateral del tórax para reforzar la revelación de dichos hallazgos. En esta serie no se observó ninguna forma puramente bronconeumónica de la neumonía de Friedländer. El infiltrado neumónico en el grupo Friedländer fué relativamente radioopaco, pero se descubrieron frecuentemente sombras de espesor semejante en otras formas de neumonía.

Si bien los hallazgos roentgenológicos en la neumonía de Friedländer no son patognomónicos, en muchos casos es posible sugerir el diagnóstico acertado por la radiografía.

Diaphragmatic Herniation of the Kidney

Case Report[1]

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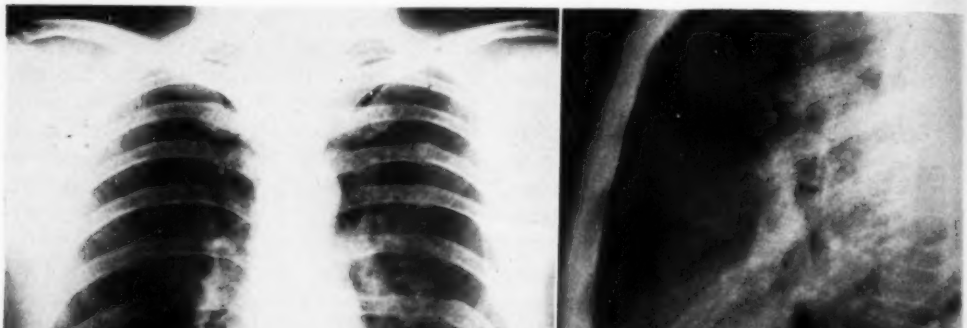
A CASE OF HERNIATION of the upper pole of the left kidney through the diaphragm is presented because of the rarity of this occurrence and the differential diagnostic possibilities to be considered. A search of the literature failed to reveal a similar case.



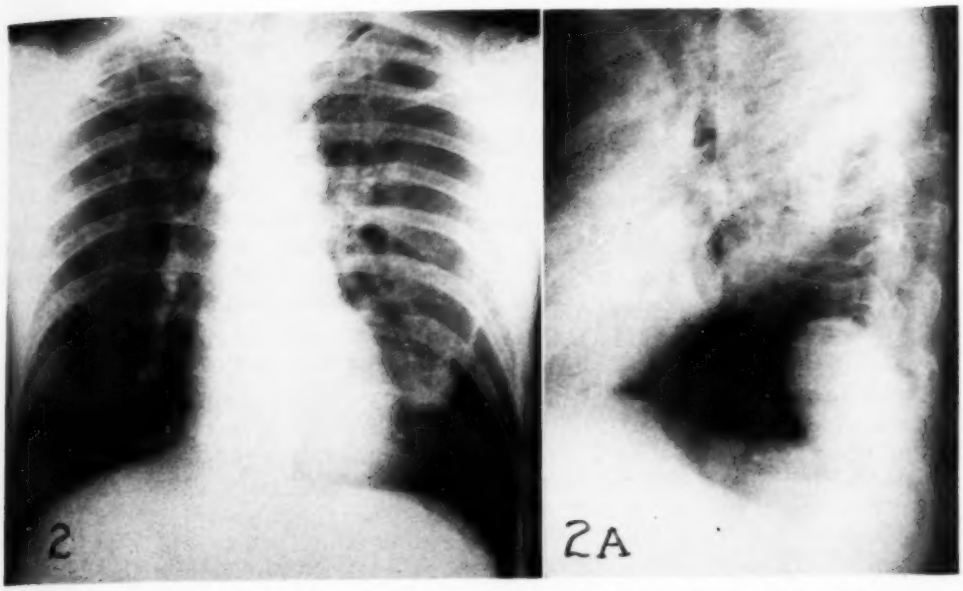
Figs. 1 and 1A. Postero-anterior and left lateral chest roentgenograms made on admission, showing fractured ribs and a well circumscribed mass in the left cardiophrenic angle (Fig. 1) located posteriorly, immediately adjacent to the diaphragm (Fig. 1A).

A 45-year-old male was admitted to the New York Hospital complaining of recurrent episodes of coughing with sputum production in the morning, during the past six months, associated with chills, low-grade fever, and chest pain. There had also been a gradual onset of anorexia, malaise, weakness, and a loss of 20 pounds in weight. A roentgenogram taken elsewhere revealed a mass in the left chest. There was no history of hemoptysis or of exposure to tuberculosis.

The patient had had the usual childhood diseases and an appendectomy at the age of nine. In 1923 he had jaundice of undetermined etiology for two months. While in the West Indies, in 1927, he had a high fever of unknown cause. Six years before admission, he had been in an automobile accident, receiving severe fractures of both legs, the left wrist, and several left ribs. The residual deformities resulted in partial disability of the extremities.

Physically the patient appeared well developed, rather thin, and in no acute distress. The significant findings were limited to the chest. The lungs were clear except for an area at the left base posteriorly, extending from T-8 to T-11 between the vertebral column and the posterior axillary line, where there were dullness, decreased fremitus, voice sounds, and breath sounds. Blood, urine, and sputum examinations were all negative.

[1] From the Department of Radiology of the New York Hospital, Cornell Medical Center, New York, N. Y.
Accepted for publication in October 1948.



Figs. 2 and 2A. Postero-anterior and left lateral roentgenograms of the chest following left artificial pneumothorax. With collapse of the lung, the mass is more clearly delineated, ruling out a pulmonary origin. The intimate association with the diaphragm is apparent. Figure 2A shows that the shape is that of the upper pole of the kidney.

Roentgenograms of the chest on admission (Figs. 1 and 1A) revealed old healed fractures of the left sixth, seventh, and ninth ribs, pulmonary emphysema, chronic interstitial fibrosis, pleural thickening at the left costophrenic angle, and a well circumscribed mass in the left posterior chest, intimately associated with the left diaphragm in its posteromedial portion. Roentgenoscopy showed the mass to move with the diaphragm, which lagged slightly.

The patient was given a left artificial pneumothorax to determine whether or not the mass was pulmonary in origin. Figures 2 and 2A show collapse of the left lung, with separation from the mass, ruling out a pulmonary tumor. Roentgen examination of the dorsolumbar spine and a gastro-intestinal series were negative. An intravenous pyelogram (30-minute film) showed the left kidney to be high in position, without other pathologic change (Fig. 3). Preoperative diagnosis was neurofibroma of the left lower posterior mediastinum.

Exploratory thoracotomy was performed under general anesthesia. Through a posterolateral incision, the left seventh rib was exposed and removed, following which the chest cavity was opened. The mass seen on the roentgenogram was found to be the upper pole of the left kidney protruding up into the thoracic cavity. The diaphragm was frayed, but was closely adherent to the kidney. No effort to dislodge the kidney was made, and the chest was closed. *Postoperative Diagnosis:* Old

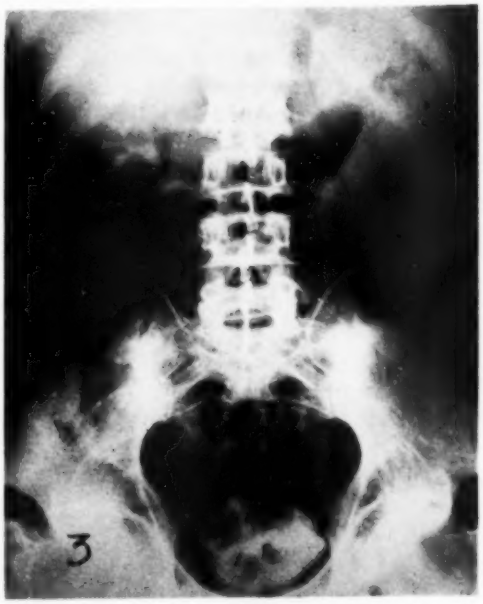


Fig. 3. Anteroposterior roentgenogram of the abdomen: thirty-minute intravenous pyelogram. Note the high position of the left kidney, the upper pole of which corresponds to the mass seen in Figures 1 and 2.

diaphragmatic rupture with upward displacement of the left kidney.

The postoperative course was uneventful.

DISCUSSION

From a roentgenologic point of view, this case offers several interesting features. On the original chest films the herniated kidney had the appearance of a mass intimately associated with the left diaphragm. Roentgenoscopically, it moved with the diaphragm, with which it maintained a constant relationship in all positions. Possible diagnoses to be considered were tumor of pulmonary parenchymal, pleural, or diaphragmatic origin, or a "dumb-bell" neurofibroma of the spinal cord. A left pneumothorax revealed that the mass was not a pulmonary tumor. X-rays of the spine showed no bone destruction or foramen enlargement. The intravenous pyelogram, however, demonstrated the high position of the left kidney. A correlation of this finding with the mass seen on the chest films should have led to a correct diagnosis.

The cause of the herniation was undoubtedly trauma. In the automobile accident six years earlier the patient evidently suffered a tear in the left diaphragm. The kidney had moved upward and filled this gap and during the process of healing the diaphragm had become closely adherent to the herniated organ.

SUMMARY

1. A case of traumatic herniation of the upper pole of the left kidney through the diaphragm is presented.

2. Herniation of kidney, although of rare occurrence, should be considered in the differential diagnosis of thoracic masses intimately associated with the diaphragm.

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SUMARIO

Herniación Diafragmática del Riñón. Historia Clínica

En el caso comunicado una masa observada en la radiografía torácica fué interpretada como tumor, pero en la exploración resultó ser el polo superior del riñón izquierdo herniado a través del diafragma. El paciente había figurado en un accidente automovilístico seis años antes, en cuya ocasión se le fracturaron varias costillas. Parece que el diafragma se desgarró entonces, y que el riñón se movió hacia arriba para llenar la solución de continuidad. Al cicatrizar, el diafragma se adhirió firmemente al riñón herniado.

Aunque la herniación del riñón es rara, hay que considerarla en el diagnóstico diferencial de las tumefacciones torácicas íntimamente asociadas con el diafragma.

A Survey of Scattered Radiation from Fluoroscopic Units in Fifteen Institutions[1]

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THE PREDOMINANT hazard encountered during a properly diaphragmed fluoroscopic examination is not the radiation direct from the primary beam but the scattered radiation originating from the following locations: (1) the under side of the table top, (2) the patient, (3) the fluoroscopic screen, (4) the walls adjacent to the fluoroscopic unit, (5) the floor.

The material presented in this article is the result of a survey of fifteen different fluoroscopic installations, including strictly upright chest units and combination radiographic and fluoroscopic examining tables.

The first objective was to determine a minimum room size in which a fluoroscopic unit, whether upright or horizontal, could be installed and have a low wall-scattering factor. Secondary to this was a desire to determine the location of the fluoroscopic table that would give the least amount of scatter from the walls of the room.

Measurements of the scattered radiation, whether from the table, patient, screen, or walls, were taken under actual diagnostic conditions and for many different types of examination. At times it was rather difficult to obtain these measurements in a small room which contained a dual-purpose fluoroscopic unit, roentgenologist, technician, and the individual conducting this survey.

All of the measurements were made with a Beckman beta-gamma survey meter, model MX-2, manufactured by National Technical Laboratories, South Pasadena, California. This instrument is completely portable and was used in preference to others because of its large direct-reading scale, which was easier to read in the subdued light. It is of the ionization chamber type, indicating the intensity of radiation in milliroentgens per hour. The window of the ion chamber consists of a sheet of celluloid 0.01 in. in thickness.

The instrument was first calibrated with gamma radiation from a known amount of radium contained in a needle having a wall thickness of 0.5 mm. of platinum. Doses of x-radiation generated at 80 kv. with and without extrinsic filter of 1 mm. of aluminum, measured with a 25-r condenser-type Victoreen ionization chamber, gave readings which were within 5 per cent of those taken with the Beckman meter.

The fifteen installations surveyed represented units manufactured by six companies. The installations included 10 tilt tables, 3 stationary horizontal tables, and 3 upright panels. All of the tilt tables were equipped with a film carriage beneath the table top for radiography with an over-the-table tube. All were completely enclosed with sheet metal except for the film carriage slot.

Table I indicates the position of the various fluoroscopic units in relation to walls of the room. Several rooms contained more than one unit. One of the horizontal units was completely enclosed with sheet metal (11-H in Table II); and the other two had no sheet metal at the ends or sides. Tables measured approximately 6 1/2 feet long and 2 1/2 feet wide. All units were operated within a potential range of 70 to 85 kv., with a current of 3 to 6 ma. None of the vertical units was totally enclosed with sheet metal.

Measurements of all horizontal units were taken at three definite locations as shown in Table II and Diagram 1.

(1) The radiation, scatter and secondary, from the table top and fluoroscopic screen was measured 6 inches from the side of the

[1] Accepted for publication in July 1948.

TABLE I: ROOM SIZES AND TABLE PLACEMENTS*

	Room Dimensions			Wall Distance from Table			
Room No.	Length	Width	Height	Wall A	Wall D	Wall C	Wall B
1	20′	14′	12′	6′0″	7′6″	5′0″	6′6″
2	18′	14′	12′	6′6″	5′0″	4′0″	7′6″
3	15′	12′	8′	3′0″	5′6″	4′6″	5′0″
4	12′	9′	9′	2′6″	3′6″	3′0″	3′6″
5	15′6″	13′6″	9′	1′6″	7′6″	2′0″	9′0″
6	16′	14′	9′	4′0″	5′6″	3′6″	8′0″
7	13′	10′	12′	3′6″	3′0″	2′0″	5′6″
8	11′6″	9′	12′	2′0″	3′0″	2′0″	4′6″
9	12′	13′6″	10′	2′6″	3′0″	4′0″	7′0″
10	15′6″	12′6″	10′	5′0″	4′0″	5′0″	5′0″
11	14′	11′6″	10′	2′0″	5′6″	1′6″	7′6″
12	14′	12′	9′	4′6″	3′0″	3′6″	′0″
13	14′	12′	9′	4′6″	3′0″	3′0″	6′0″
14	16′	10′	10′	5′0″	4′6″	3′6″	4′0″
15†	12′	5′	10′	..	..	10″	4′0″

* Several rooms contained 2 units. All tables measured approximately 6′6″ × 2′6″.
† Upright fluoroscope only.

table, directly opposite the x-ray tube and in the same plane as the film carriage opening.

(2) Scattered radiation from the walls was measured by aiming the Beckman meter at the four walls from the position normally occupied by the roentgenologist.

(3) The scattered radiation impinging on the roentgenologist's legs was measured.

Table II is a compilation of the data obtained. In column 1 the symbol "H" indicates that the tilt table was in the horizontal position, "V" indicates the vertical position, and "U" indicates a stationary upright fluoroscopic unit. Column 4 shows the physical type of patient being examined: "A" designates a muscular person covering most of the table top; "B," an obese patient covering about the same area of the table top as "A"; "C," a small person covering a relatively small area.

The sum of the scattered radiation from the table top, patient, and screen appears in column 5. Columns 6, 7, 8, and 9 show the intensity of scatter impinging on the roentgenologist from the walls of the room (see Diagram 1). Column 10 shows the measurement of scatter which was impinging on the examiner's legs whether it be from the floor, lower part of the wall, under part of the table, or through the back of the tube housing.

In all cases where students or technicians assisted the examiner, particular care was taken to determine the amount of radiation received by them.

Measurements taken just above the shoulders of the roentgenologist with the table in the vertical position and with a field size of approximately 10 × 13 cm. showed that he received through the fluoroscopic screen assembly less than 0.0006 r per examination.

In Table III, column 2 headed "Maximum r per patient without lead apron" represents the total radiation from the previously mentioned sources which would be

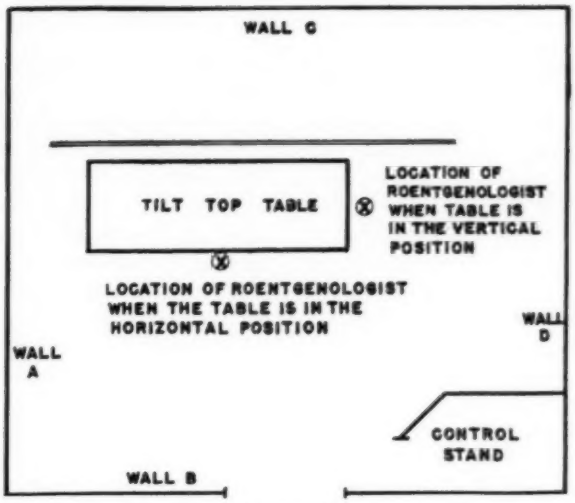

Diagram 1

TABLE II: RADIATION RECEIVED FROM VARIOUS SOURCES BY EXAMINER

Installation Number*	Kv.	Ma.	Physical Type of Patient†	Meter Reading (mr./hr.) at Front of Table	Mr. per Patient Arriving at Examiner from				
					Wall A	Wall B	Wall C	Wall D	Floor
Column → 1	2	3	4	5	6	7	8	9	10
1-H	75	4	B	205	0.132	0.2	1.2	0.264	0.8
1-V	75	4	A	225	0	0.264	1.32	1.04	1.14
2-H	75	4	A	255	0	0.264	1.2	0.332	0.66
2-V	75	4	A	240	0	0.332	1.26	1.32	1.6
3-H	75	4	B	260	0.264	0.332	1.04	0.332	0.8
3-V	75	4	B	245	0	0.264	0.92	0.72	1.35
4-H	80	4	C	390	..	1.20	2.0	0.4	1.5
4-V	80	4	C	385	0	1.32	2.2	1.72	2.0
5-H	80	4	B	295	0.8	0.92	10.8	0.664	12.6
6-H	80	5	B	340	0	0.4	1.2	0.4	0.8
6-V	80	5	B	330	0	0.45	1.2	0.8	1.35
7-H	80	4	A	245	0.132	0.264	0.92	0.2	0.675
7-V	75	4	B	210	0	0.332	0.92	0.528	0.104
8-H	80	4	B	290	0	0.45	1.2	0.132	0.528
8-V	80	4	B	295	0	0.45	1.32	0.8	1.2
9-H	70	5	B	205	0.264	0.132	1.04	0.528	0.66
9-V	70	5	B	215	0	0.132	1.04	1.056	1.32
10-H	75	5	B	165	0	0	0.92	0.264	0.56
10-V	75	5	B	180	0	0.132	0.8	0.4	0.8
11-H	70	4	A	65	0.4	0.2	5.2	0.132	0.4
12-H	80	5	B	220	0.264	0.4	1.32	0.4	0.6
13-H	75	5	B	250	0	0.264	1.2	0.45	0.8
13-V	75	5	A	270	0	0.264	..	0.6	1.06
14-H	80	4	B	215	0	0.4	0.92	0.66	0.94

Installation Number	Kv.	Ma.	Physical Type of Patient	Meter Reading (mr./hr.) 12″ from Side of Panel (Technician)	On Arms of Radiologist	On Legs of Radiologist
8-U	65	4	A	410	0.009	6.0
11-U	70	4	B	370	0.006	8.0
15-U	70	3	B	390	0.004	8.0

* H. Tilt table in horizontal position. V. Tilt table in vertical position. U. Stationary upright fluoroscopic unit.

† See text for explanation.

received by the roentgenologist during a single examination of average time if he did not wear a rayproof apron. Column 3 shows the number of patients that could be examined per day, if no apron were worn, before exceeding the present permissible tolerance dose. Column 4 presents the maximum r per patient that the roentgenologist would receive when wearing a lead-rubber apron, while column 5 indicates the number of patients that could be examined under conditions set forth in column 4 before exceeding 0.1 r.

To explain further the maximum r received by the examiner, as shown in Table III, let us take for an example installation 1-H. This installation was in a hospital where an average of 25 patients per day are examined. The roentgenologist wore a lead-rubber apron and lead-rubber gloves. When facing the table squarely so that the lead-rubber apron covered the front of his body, the only scatter received was from the walls. This amount was well below the permissible tolerance dose for an eight-hour day. If he turned at right angles to the table, his side or back was exposed to radiation to the amount of 0.205 r per hour (Table II, 1-H). The average examination by this roentgenologist required the x-ray tube to be energized for approximately four minutes. The dose received by the examiner for this particular x-ray table for one examination, if he did not wear an apron, was 0.014 roentgen. Thus only 7 patients could be examined during an eight-hour day without exceeding the permissible tolerance dose. Very little difference was found in the scattered radiation from the walls or film carriage slot when this table was moved from the horizontal to the vertical position.

In one institution having two tables of the same make, the scattered radiation from each table, patient, and screen was decreased by 35 per cent when a piece of aluminum 1 mm. thick was placed in the lead cone which is located between the tube and the table top. This added thickness of aluminum did not decrease the brilliance of the fluoroscopic screen or impair detail; neither did it affect the readability of spot films.

As the tube and screen were moved from the apex of the chest to the lower abdomen, the scattered radiation from the patient increased approximately 60 per cent.

We have observed several aprons that appear to be a little short of offering good body protection. Several did not extend far enough around the buttocks to protect the wearer when he stands obliquely to the table to examine a patient in the horizontal position. When this condition exists, one must consider the wearer to be receiving the "maximum r."

Several installations presented radiation hazards which could be overcome by using a movable barrier. At one institution (Table II, 2-H, column 5) several interns had been watching 6 fluoroscopic examinations from the side of the table, the examinations averaging four minutes each. One of the group was wearing a lead-rubber apron, but the others were not. In this position they were receiving the scattered radiation escaping from the film carriage slot, the table top, the patient, and the fluoroscopic screen, the total amount being 255 mr. per hour (0.255 r/hr.). Breaking this quantity of radiation down to r per patient would give $0.255/60 \times 4 = 0.017$ r per patient. This would limit the interns to 6 patients per day under the present permissible dose, except for the one wearing the apron. In this case the apron would reduce the radiation striking the intern to a negligible amount.

Technicians assisting with the examinations in nearly every instance received more radiation than did the roentgenologist. Upright units were the worst offenders in this respect, since the technicians were required to stand at the side of the unit and were thus exposed to scatter from the walls, patient, front panel, and screen. During one survey a student nurse was standing beside the upright unit and in this position she could have assisted in the examination of only 5 patients per day before receiving more than 0.1 r. The installation of a suitable barrier at the side of this unit

TABLE III: PERMISSIBLE EXAMINATIONS WITHOUT AND WITH RAYPROOF APRON

Installation Number*	Maximum r per Patient without Lead Apron $\times 10^{-3}$	No. Examinations to Approach Tolerance	Maximum r per Patient with Lead Apron $\times 10^{-3}$	No. Examinations to Approach Tolerance
1-H	14.0	7	2.6	39
1-V	3.76	26	3.5	29
2-H	18.0	5	2.5	40
2-V	4.5	22	4.0	25
3-H	18.5	5	2.7	37
3-V	3.4	29	3.2	31
4-H	26.0	3	5.1	20
4-V	6.4	15	6.0	16
5-H	19.5	4	25.7	4
6-H	22.5	4	2.8	36
6-V	3.8	26	3.6	28
7-H	16.3	6	2.2	46
7-V	1.8	55	1.6	62
8-H	19.2	5	2.3	43
8-V	3.8	26	3.6	28
9-H	14.0	7	2.6	39
9-V	4.0	25	3.7	27
10-H	1.0	9	1.7	58
10-V	2.2	46	2.0	50
11-H	4.0	25	6.3	16
12-H	15.0	6	3.0	33
13-H	16.5	6	2.7	37
13-V	2.0	50	1.8	55
14-H	14.5	7	2.9	34
Vertical units				
8-U	27.0	4	8.6	12
11-U	24.0	4	7.9	13
15-U	26.0	4	14.2	7

* H. Tilt table in horizontal position. V. Tilt table in vertical position. U. Stationary upright fluoroscopic unit.

would eliminate this condition. A lead-rubber apron hung between the nurse and the x-ray tube would have allowed her to assist with 33 examinations before exceeding 0.1 r.

Another condition which proved to be common to both upright units and tilt tables when in the vertical position was the scattered radiation from the patient and fluoroscopic screen impinging on the doctor's unprotected legs. In no case was the lead-rubber apron sufficiently long to reach below the knees in the sitting position. An average of 120 mr. per hour (0.120 r/hr.) was measured at knee height. Twelve patients, 0.008 r per patient, could be examined in this position before the permissible tolerance dose was approached. This scatter was completely absorbed by the use of a fluoroscopic chair provided with a piece of lead-rubber extending to the floor.

In several hospitals the technicians operated the control panel which was located near the fluoroscopic unit. In these installations the technician was receiving radiation from the patient and wall behind the control stand. In 5 installations the scattered radiation bounding off the wall would limit the technician to 11 patients per day before permissible tolerance was reached.

The following statements are based on the assumption that the roentgenologist and the assisting technician fully utilize the present rayproof aprons and gloves.

From the data presented in Table II, columns 6, 7, 8, and 9, which apply to tilt tables and stationary horizontal tables, it is concluded that the minimum room dimensions should be 12 × 14 feet. This will allow the table to be located far enough away from the walls to reduce the scatter to a minimum. A room of smaller dimensions requires that the roentgenologist be too close to at least one wall, whether he is standing at the side of the table or in front of the upright unit. There should be at least 6 feet between the roentgenologist and the closest wall, regardless of the type of examination being carried out.

All of the rooms surveyed are close to 12 × 14 feet except rooms 4 and 8. Room 4 (12 × 9 feet) has nothing against the walls which might act as a diffuser for the scattered radiation, while the two walls (Table I, walls B and D) behind the roentgenologist, when he stands in the two usual examining positions in room 8 (11 feet 6 inches × 9 feet) were lined with cabinets and shelves which cut to a minimum the amount of scatter he received on his back. In room 4 the scatter from wall B, which is 3 feet 6 inches from the table, was increased by approximately 35 per cent over rooms measuring 12 × 14 feet. The scatter from wall D, which also was 3 feet 6 inches from the table, increased 26 per cent as compared with a room 12 × 14 feet.

None of the stationary upright units located in a corner of a room presented a hazardous condition for the roentgenologist, but, when a technician is present standing at the side of the unit next to the wall, she receives a large amount of scattered radiation from the wall.

NOTE: The authors wish to thank Dr. J. H. Marks, Roentgenologist of The New England Deaconess Hospital, for his many suggestions and critical review of the text.

New England Deaconess Hospital
Boston 15, Mass.

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SUMARIO

Estudio de la Radiación Esparcida por los Aparatos Roentgenoscópicos de Quince Instituciones

El objeto primordial de este estudio de quince distintas instalaciones de fluoroscopia era determinar el tamaño mínimo del cuarto en que podía instalarse una unidad roentgenoscópica, ya vertical u horizontal, con poco esparcimiento desde las paredes. Hicierónse mediciones de la radiación esparcida, incluso de las paredes, la mesa, el enfermo y la pantalla fluoroscópica, en las mismas condiciones en que se hace el diagnóstico, con varias clases de examen y enfermos de diversos tipos físicos.

De los datos obtenidos dedúcese que las dimensiones mínimas del cuarto deben ser 3.6 por 4.2 m., lo cual permitirá situar la mesa a distancia suficiente de las paredes para rebajar la dispersión al mínimo. Debe haber por lo menos 1.8 m. de distancia entre el radiólogo y la pared más cercana, independientemente de la clase de examen que se ejecute.

Repásanse sucintamente otras medidas destinadas a la protección del radiólogo y los demás técnicos, incluso modificaciones de los delantales de caucho-plomo y empleo de vallas movibles.

Hand Timer for Spot-Film Work[1]

GERHART S. SCHWARZ, M.D.
Clifton Springs, N. Y.

THE DESIRABILITY of setting the exposure factors before the taking of each spot film in a single examination is widely recognized. The Morgan photo-electric timer offers an ideal method of accomplishing this. Because the timer is completely automatic, it relieves the radiologist of any concern with the matter of exposure. It is the object of the present paper to describe another device for solving this same problem, which can be adapted at low cost to almost any of the rigid filming fluoroscopes now in use.

This device consists of a small motor-driven timer attached to the screen-carrying arm of the fluoroscope, to be set by the examiner during the examination. The smallest motor-driven timer now available is one manufactured by the Liebel-Flarsheim Company, the specifications for which call for its operation in the upright position, permitting a deviation of not more than 15 degrees to either side of a vertical axis. To meet these specifications on a tilting fluoroscope, the timer is hinged to a strip of band iron, by which it is attached to the screen-carrying arm. With this arrangement, gravity causes the timer to be suspended in the upright position regardless of the tilt of the table (Fig. 1).

The weight of the timer is approximately 2 1/2 lb., which makes it necessary to change the counterbalance governing the screen travel parallel to the long axis of the table. With the particular filming fluoroscope used by the author the counterbalances controlling screen travel across the table and toward the tube were not affected.

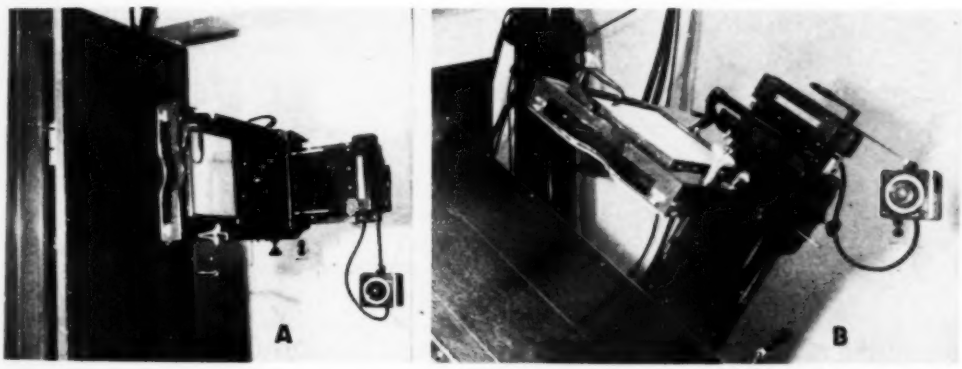


Fig. 1. View of timer hinged to the screen column. A. Fluoroscopic table in upright position. B. Table tilted into an oblique plane. The position of the timer is not affected.

The timer contacts are connected to the foot - switch - controlled exposure circuit. The timer can be set under visual control or by counting the number of clicks caused by the turning of the dial. For visual control a built-in light is used, four layers of red cellophane being placed behind the illuminating window of the dial in order that there may be no interference with the dark adaptation of the examiner's eyes. The illuminating bulb (6 v., 0.25 A.) is fed from the 110-volt line over a serial resistor

[1] From the department of Radiology, Clifton Springs Sanitarium and Clinic, Clifton Springs, N. Y. Accepted for publication in October 1948.

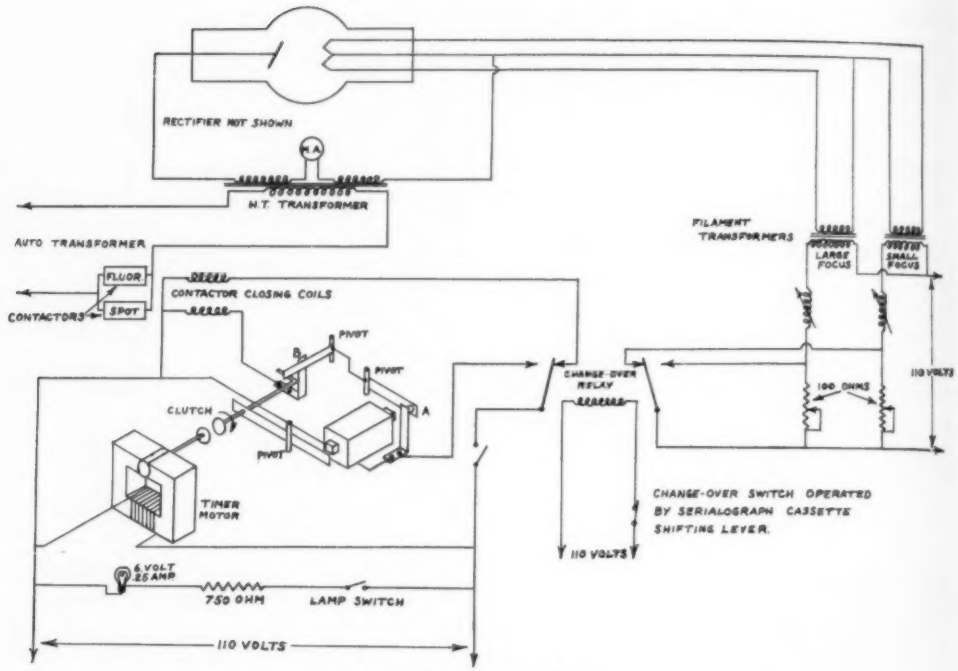


Fig. 2. Simplified circuit diagram.

of 750 ohms (Fig. 2). This resistor is likewise built into the housing of the timer. Since heat is generated if the dial illumination is left on for too long a time, it is advisable to turn it off as soon as the timer is set. This is accomplished by means of a hand switch, which is also built into the wall of the timer housing. For permanent illumination, the resistor would have to be mounted on the outside of the timer or would have to be replaced by a choke coil. In practice the clicking of the dial has been found to be a reliable guide for setting the timer in absolute darkness or during fluoroscopy, and the author has largely abandoned use of the illuminator.

The excursion of the time-setting dial is confined by a stopscrew which limits the maximal single exposure time to one and one-quarter seconds. This has two purposes: (1) it prevents overloading of the x-ray tube target; (2) it further facilitates the manual "blind" setting by allowing the operator to count the number of clicks from either end of the dial travel.

Under actual working conditions the exposure time is principally determined by the position of the patient and the degree of compression. On the machine used by the author, the settings of the exposure circuit of the filming fluoroscope are maintained at 85 kv.p. and 110 ma. at all times. With these settings, Kodak blue brand films, Patterson par-speed screens, a target-film distance of 18 to 28 inches, and the use of a stationary Lysholm-Schoenander grid, the exposure times for the average patient are as follows:

Cervical esophagus, postero-anterior	0.1 to 0.2 second
Thoracic esophagus, oblique or lateral, if not superimposed upon the spine but contrasted against air-containing lung tissue	0.3 second
Stomach, postero-anterior upright	0.7 second
Stomach, postero-anterior supine	0.6 second
Stomach, postero-anterior upright; mild compression to show gastric folds	0.4 second

Duodenal bulb, postero-anterior, upright, without compression	0.7 second
Duodenal bulb, upright oblique, without compression, depending on the angle	0.7 to 1.25 second
Duodenal bulb, heavily compressed by cone (fairly independent from angle)	0.3 second

Without the grid the exposure times can be reduced to approximately half of the above values. Working without the grid makes the prediction of the necessary exposure time somewhat more difficult, however, because it is then dependent also upon the size of the field, *i.e.*, the larger the shutter opening, the shorter the exposure time.

The timer settings are by no means as critical as the above table might imply. For practical purposes a timer with a choice of four or five settings, *e.g.*, 0.1, 0.2, 0.4, 0.8, (1.5) second is entirely adequate and probably to be preferred.

The size of the patient influences the exposure time less than one might expect. It is safe to reduce the time roughly about 30 per cent for a slender patient, and to increase it 50 per cent for a large patient. The only difficulty is presented by oblique or lateral views of the duodenal bulb, which are apt to be underexposed in heavy patients even with exposures of more than one second. On the other hand, there is less difference between medium and heavy patients when taking compression views.

The filming of the rectosigmoid in oblique projection through pelvic bones requires (with the aforementioned settings) approximately 1.6 seconds, and in lateral projection approximately 2.5 seconds. (This is almost independent of the size of the patient.) The tube load limit of the machine may make it necessary to divide the exposure in these cases. The new rotating anode tubes which are now available for spot-film work will solve this difficulty.

After working with a timer of the type described for a short time, one acquires a sense of estimation which makes its setting an almost automatic procedure. Once this point is reached, the added convenience will be fully appreciated.

SUMMARY

A small motor-driven timer is described, which is permanently attached to a filming fluoroscope, permitting the examiner to vary and to preset the exposure of spot films instantaneously during fluoroscopy.

NOTE: The author expresses his appreciation of the valuable help of Mr. Leslie R. Middlecote in installing this timer and advising on the circuit.

Clifton Springs Sanitarium and Clinic
Clifton Springs, N. Y.

SUMARIO

Cronógrafo Manual para Radiografías Instantáneas

El cronografillo descrito, impulsado por motor, está permanentemente unido a un fluoroscopio radiografiador, y permite que el examinador fije de antemano y cambie momentáneamente la exposición de las radiografías instantáneas durante la roentgenoscopia.

EDITORIAL

London, 1950

London, thou art of townes A per se
Soveraign of Cities, seemliest in sight,
Of high renoun, riches and royalties;
Of lordis, barons, and many a goodly knyght;
Of most delectable lusty ladies bright;
Of famous prelatis, in habitis clericall;
Of merchauntis full of substance and of myght:
London, thou art the flour of Cities all.

William Dunbar, 1465–*c.*1520

More than one writer has attempted to assess the relative merits of travel and arrival. There are probably as many motives for leaving home as there are voyagers who decide to go to a far country. But whether a man really believes that to travel is better than to arrive, or whether he regards a proper journey as the shortest possible distance between two points on the earth's surface, nearly every traveller prefers to have a semblance of excuse for his undertaking, if not an actual reason.

An International Congress provides much more than either of these to the would-be traveller. Indeed, attractions are offered in such variety that the non-participant almost feels he should find justification for his absence rather than an explanation for his decision to make the venture.

The preliminary programme, just published, of the next International Congress of Radiology extends to all radiologists a most cordial welcome to London during the last week in July 1950, with the reminder that "the triennial Congresses were a conspicuous feature of radiological life in pre-war days and made possible many a pleasant friendship, and that, as a forum for exchange of scientific ideas, they were of immense value, scientific radiology having lost much by their interruption." They are to be brought to life again next year, when the Sixth Congress of the series will be held in a group of buildings under the shadow of the Palace of Westminster and within sight and sound of Big Ben—probably the best loved clock in the world—whose silhouette is to be the emblem of the gathering.

The main meetings will be held in the building which housed the Preliminary International Congress of Radiology in 1925, re-christened later the First International Congress of the series. This Congress was opened by H.R.H. the Duke of Connaught, the great-great-uncle of H.R.H. Princess Elizabeth, who hopes to be present at the opening ceremony of the 1950 Congress in this very hall.

Four hundred and seventy delegates attended the first meeting, of whom 207 were British; 65 delegates came from Germany, 63 from America, 24 from Russia, 20 from Belgium, 16 from France, 12 from Holland, and lesser numbers from Austria, Argentina, Canada, Czechoslovakia, Denmark, Egypt, Hungary, Italy, India, Iceland, Jugoslavia, Norway, Poland, Spain, Switzerland, Sweden, South Africa, and Turkey. It is not in the least improbable that many times that number will attend the Sixth Congress. From the United States alone we are told that over 300 have already made reservations. The prospectus of that first meeting, in which radiologists from all over the world were invited to enroll, announced that "the accommodation at Central Hall is practically unlimited for our purpose." To provide accommodation for all the Congress activities next year, it has been necessary, in addition to the Central Hall, to acquire Church House (Westminster), Ashburnham House, and the Caxton Hall; and for the technical exhibition the two Royal Horticultural Halls.

Church House, Westminster, was, "as

Photo by L. H. Burd, A. R. P. S.

Ashburnham House, Westminster, to be the Social Centre of the Sixth International Congress of Radiology, July 23–29, 1950.

occasion required" during the years 1940–41 and 1944, used as the Chamber of the House of Commons. From here Winston Churchill, in the darkest days of the war (1940), spoke to the Commons and to the Nation words which are now recorded on a panel in one of the Conference Rooms:

"Today, in inaugurating a new Session of Parliament, we proclaim the depth and sincerity of our resolve to keep vital and active, even in the midst of our struggle for life, even under the fire of the enemy, those parliamentary institutions which have served us so well, which have proved themselves the most flexible instruments for securing ordered unceasing change and progress: which, while they throw open the portals of the future, carry forward also the traditions and glories of the past and which, at this solemn moment in the world history, are at once the proudest assertion of British freedom and the expression of an unconquerable national will."

Ashburnham House, now part of Westminster School, will be the social centre of the Congress. It adjoins Westminster

Abbey and is built on 14th century foundations, having once been the prior's lodging. Some of its windows are of an earlier date than the present Abbey buildings, and some of the stones are undoubtedly of the 11th century. The main decorations are 17th century work of Inigo Jones. The Caxton Hall is a series of halls conveniently arranged for conference purposes, but without special historical interest.

The Royal Horticultural Halls provide space of over 30,000 sq. ft. and are some of London's finest exhibition premises. As the preliminary programme reminds us, this will be the largest exhibition of radiological apparatus ever held. The larger hall overlooks Vincent Square, a large open space now used as a playing field. This area has remained undeveloped for over 300 years and is reputed to have been one of the burial grounds for those who died in the Great Plague. There are no ghosts!

Among other places of interest which members will have an opportunity of visiting during Congress week is Lancaster House, where the Government reception will be held. This was built as a residence for Frederick, Duke of York, son of George III, but being unfinished at the time of his death, it became the town house of the Dukes of Sutherland. This house was presented to the nation by the late Lord Leverhulme and used to display some remarkably interesting antiquities associated with the history of London.

During the Congress week Windsor Castle will be visited by associate members. It is built on the "great hill" first palisaded by the ancient Britons and then the site of William the Conqueror's fortress. It is surrounded by the forest and parkland which he made his playground. Here Henry I held his marriage feast and from the Castle John went forth to seal Magna Charta at nearby Runnymede. The Castle was practically re-made by Edward III (1356), while the Chapel was built by his great-great-grandson, Edward IV (1461–83). The building is astonishingly massive, with its towers, bastions, moat and loopholed towers, its sally-ports, surprise holes, underground passages, and walls of bomb-proof thickness. Yet of the apartments, Harriet Beecher Stowe could write: "The whole air of these rooms was very charming ... the idea of a home, which pervades everything in England from the cottage to the palace, was as much suggested here as in any apartment I have seen."

For the week following the Congress a number of tours are being arranged to centres of interest in Great Britain and Ireland, and offering a great choice of attractions. One can visit Sulgrave Manor, George Washington's ancestral home, the Lorna Doone country, or pay homage to Burns, the Scottish bard; one can explore the glens and lochs of Scotland, the Lake country, or the beautiful Irish mountains of Donegal and Killarney, or one can choose between the twentieth century at Harwell Atomic Energy Station and the relics of Roman times at Chester.

This editorial is mainly concerned with London and has leant towards review of its essential attractions. So we must not forget that the real core of the Congress is scientific work. There are to be five sections, including diagnosis, therapy, biology, physics, and electrology, though for convenience electrology will be organised as a sub-section of radiotherapy. In association with these sections, there will be a scientific exhibition demonstrating recent advances in the art and science of radiology. This will consist of a series of invited exhibits and, so far as space allows, those proffered by members of the Congress. Further details, as to the programme will appear later.

These are what London offers you in 1950. What is not said but should now be added is that it offers these along with the cordial welcome Britain ever extends to its distinguished visitors from overseas. Post-war England lacks many of the more spacious luxuries of pre-war days but there will be no shortage of friendly hosts to those who decide to visit it in 1950.

RALSTON PATERSON
F. GORDON SPEAR

Can Corporations Such as Hospitals Legally Engage in the Practice of Medicine?

Attention is directed to an article by Wilbur Bailey, M.D., which appears in the August 1949 issue of the *News Letter* of the College of Radiology. In this article Dr. Bailey quotes the Attorney General of California, who on May 19, 1948, rendered the opinion that a corporation cannot directly or indirectly engage in the practice of medicine, citing legal bases for this statement.

According to Dr. Bailey, this ruling is already having good results in California, although "it is not to be expected that longstanding abuses will vanish overnight." He believes that it is the province of members of the American Medical Association to work toward ending existing abuses and also to strengthen the medical practice acts in the various states, making these laws more readily enforceable.

RADIOLOGICAL SOCIETY OF NORTH AMERICA

THIRTY-FIFTH ANNUAL MEETING

Cleveland, Ohio, Dec. 4–9, 1949

PRELIMINARY PROGRAM

Monday, December 5

GENERAL SESSION: 10:15 A.M.

Opening Ceremonies

Presidential Address, EDGAR P. MCNAMEE, M.D., Cleveland, Ohio.

New Developments in the Cancer Field, SHIELDS WARREN, M.D., Boston, Mass. (by invitation).

COUNSELORS' LUNCHEON: 12:30 P.M.
Hotel Statler

DIAGNOSTIC SESSION: 2:00 P.M.

SYMPOSIUM ON CANCER OF THE STOMACH

Fred J. Hodges, M.D., Ann Arbor, Mich., Presiding

Medical Aspects of Gastric Neoplasia. CHARLES L. BROWN, M.D., Philadelphia, Penna. (by invitation).

Standard Radiologic Methods Used in the Search for Gastric Tumors.

The Application of Mass Photofluorographic Methods for Surveying Large Population Groups for Gastric Tumors, JOHN ROACH, M.D., Baltimore, Md. (by invitation).

A New Method for Visualization of Gastric Mucosa Using Oily Contrast Media. CESARE GIANTURCO, M.D., Urbana, Ill.

The Histological Characteristics and Growth Behavior of Primary Gastric Tumors.

The Present Status of the Surgical Treatment of Gastric Tumors, CARL MOYER, M.D., Dallas, Texas. (by invitation).

THERAPY SESSION: 2:00 P.M.

SYMPOSIUM ON THE TREATMENT OF CANCER OF THE BREAST

Harold W. Jacox, M.D., New York, N. Y., Presiding

Surgical Aspects. CUSHMAN D. HAAGENSEN, M.D., New York, N. Y. (by invitation).

Tissue Dose in Irradiation of the Breast. VINCENT P. COLLINS, M.D., New York, N. Y. (by invitation).

Radiological Aspects. URSUS V. PORTMANN, M.D., Cleveland, Ohio.

Hormonal Aspects. IRA T. NATHANSON, Boston, Mass. (by invitation).

EXECUTIVE SESSION: 4:30 P.M.

Tuesday, December 6

GENERAL SESSION

SYMPOSIUM ON ROENTGENOLOGIC PROCEDURES IN THE DIAGNOSIS OF TUMORS OF THE SMALL AND LARGE INTESTINE
10:15 A.M

Robert D. Moreton, M.D., Temple, Texas, Presiding

Roentgenographic Examination of the Small Intestine. EDWARD L. JENKINSON, M.D., Chicago, Ill.

General Considerations in Roentgenographic Examination of the Colon. JOSEPH C. BELL, M.D., Louisville, Ky.

Double-Contrast Examination of the Colon. ROBERT D. MORETON, M.D., Temple, Texas.

SYMPOSIUM ON INTRATHORACIC TUMORS
11:20 A.M.

Laurence L. Robbins, M.D., Boston, Presiding

Differential Diagnosis of Intrathoracic Neoplasm. LEO G. RIGLER, M.D., Minneapolis, Minn.

Hamartoma of the Lung. WILLIS E. LEMON, M.D. (by invitation), AND C. ALLEN GOOD, M.D., Rochester, Minn.

EXECUTIVE SESSION: 1:45 P.M.

DIAGNOSTIC SESSION: 2:00 P.M.

SYMPOSIUM ON INTRATHORACIC TUMORS
(continued)

Pulmonary Adenomatosis. Four Cases. J. CASH KING, M.D., AND DAVID S. CARROLL, M.D., Memphis, Tenn.

Pulmonary Adenomatosis: Further Roentgenologic Observations. LESTER W. PAUL, M.D.,: AND JOHN H. JUHL, M.D. (by invitation), Madison, Wis.

Importance of the Bronchopulmonary Segment and the Segmental Bronchus in the Diagnosis and Management of Tumors of the Bronchi and Lungs. CHEVALIER L. JACKSON, M.D., Philadelphia, Penna. (by invitation).

The Pathologist's Approach to Pulmonary Neoplasm. ALAN R. MORITZ, M.D., Cleveland, Ohio (by invitation).

Surgical Experience of Asymptomatic Intrathoracic New Growths. SAMUEL O. FREEDLANDER, M.D., Cleveland Heights. Ohio (by invitation).

THERAPY SESSION: 2:00 P.M.

SYMPOSIUM ON EPIDERMOID CARCINOMA OF THE UPPER MUCOUS MEMBRANE TRACT

Douglas Quick, M.D., New York, N. Y., Presiding

Measurements of the Radiation Dose from the Nasopharynx Radium Beta Ray Applicator. CARL B. BRAESTRUP, Ph.D., New York, N. Y.

Some Experiences with Surgical Exposure for More Accurate Radium Therapy in Carcinoma of the Maxillary Antrum. VINCENT P. COLLINS, M.D. (by invitation), and JOHN L. POOL, M.D. (by invitation), New York, N. Y.

Treatment of Tumors of the Nasopharynx and Hypopharynx by Irradiation. THEODORE P. EBERHARD, M.D., Philadelphia, Penna.

Carcinoma of the Floor of the Mouth. WILLIAM S. MACCOMB, M.D., New York, N. Y.

Supervoltage X-Ray Therapy in Cancer of the Mouth and Throat. MILFORD D. SCHULZ, M.D., Boston, Mass. (by invitation).

Surgical Management of Cervical Lymph Node Metastases. GRANTLEY W. TAYLOR, M.D.

Treatment of Metastatic Cervical Lymph Nodes with Irradiation Alone. CHARLES L. MARTIN, M.D., Dallas, Texas (by invitation).

THE CARMAN LECTURE: 8:00 P.M.

CONTRAST MYELOGRAPHY, PAST AND PRESENT

John D. Camp, M.D., Rochester, Minn.

(At the Hotel Statler)

Wednesday, December 7

GENERAL SESSION: 10:15 A.M.

SYMPOSIUM ON BONE TUMORS

Aubrey O. Hampton, M.D., Washington, D. C., Presiding

Diagnosis and Differential Diagnosis of Giant-Cell Tumor. HENRY L. JAFFE, M.D., New York, N. Y. (by invitation).

Reticulum-Cell Sarcoma of Bone. NORMAN L. HIGINBOTHAM, M.D., New York, N. Y. (by invitation).

Classification of Malignant Sarcoma. PAUL C. HODGES M.D., Chicago, Ill.

Post-Irradiation Bone Tumors. HOWARD HATCHER, M.D., Chicago, Ill. (by invitation).

Radiobiologic Background of Treatment of Bone Tumors. MILTON FRIEDMAN, M.D., and RALPH PHILLIPS, M.D. (by invitation), New York, N. Y.

DIAGNOSTIC SESSION: 2:00 P.M.

SYMPOSIUM ON PEDIATRIC ROENTGENOLOGY

Edward B. D. Neuhauser, Boston, Mass., Presiding

Diastematomyelia. EDWARD B. D. NEUHAUSER, M.D., Boston, Mass.

Treatment of Leukemia and Allied Disorders with Folic Acid Antagonists: The Effects of Aminopterin on Skeletal Lesions. FREDERIC N. SILVERMAN, M.D., Cincinnati, Ohio (by invitation).

Neuroblastoma. MARTIN WITTENBORG, M.D., Boston, Mass. (by invitation).

Adenocarcinoma of the Choroid Plexus. JAMES B. CAMPBELL, M.D., Topeka, Kansas (by invitation).

Wilms' Tumor. ROLFE M. HARVEY, M.D., Bryn Mawr, Penna. (by invitation).

THERAPY SESSION: 2:00 P.M.

TUMOR CONFERENCE

Eugene P. Pendergrass M.D., Philadelphia, Penna., Presiding

The subjects to be considered include Lymphoblastoma, Chronic Leukemia, Carcinoma of the Lip, Carcinoma of the Prostate, Carcinoma of the Breast, and Testicular Tumors.

The participants will be:

HYMER L. FRIEDELL, M.D., Professor of Radiology, Western Reserve University.

HARRY HAUSER, M.D., Assistant Professor of Radiology, Western Reserve University.

JOHN B. HAZARD, M.D., Pathologist, Cleveland, Ohio.

ROBERT W. HEINLE, M.D., Associate Professor of Medicine, Western Reserve University.

WM. E. HOWES, M.D., Director, Brooklyn Cancer Institute, Brooklyn, N. Y.

JAMES J. JOELSON, M.D., Associate Clinical Professor of Genito-Urinary Surgery, Western Reserve University.

RALPH JONES, JR., M.D., Director of Clinical Investigation in Cancer in Medicine, University of Pennsylvania.

JOHN H. LAZZARI, M.D., Assistant Clinical Professor of Surgery, Western Reserve University.

Thursday, December 8

GENERAL SESSION: 10:15 A.M.

SYMPOSIUM ON TUMORS OF THE URINARY TRACT

Paul C. Swenson, M.D., Philadelphia, Penna., Presiding

Diagnosis of Renal Tumors in the Adult. DAVID M. DAVIS, M.D, Philadelphia, Penna. (by invitation).

Urographic Diagnosis of Urinary Tract Tumors in Children. MEREDITH F. CAMPBELL, M.D., New York, N. Y. (by invitation).

EXECUTIVE SESSION: 1:45 P.M.

DIAGNOSTIC SESSION: 2:00 P.M.

SYMPOSIUM ON DISEASES AND TUMORS OF THE SKULL AND BRAIN

Merrill C. Sosman, M.D., Boston, Mass., Presiding

Tumors of the Cranial Bones. BARTON R. YOUNG, M.D., Philadelphia, Penna.

Roentgenologic Significance of Intracranial Calcification. JOHN D. CAMP, M.D., Rochester, Minn.

Cerebral Angiography. CARL LIST, M.D., Grand Rapids, Mich. (by invitation).

Cerebral Pneumography. FRED J. HODGES, M.D., Ann Arbor, Mich.

Radiation Therapy of Brain Tumors. CARLETON B. PEIRCE, M.D., Montreal, Quebec.

Localization of Brain Tumors by Radioactive Fluorescent Methods. GEORGE MOORE, M.D., Minneapolis, Minn. (by invitation).

THERAPY SESSION: 2:00 P.M.

SYMPOSIUM ON CANCER OF THE CERVIX UTERI

A. N. Arneson, M.D., St. Louis, Mo., Presiding

The Gynecological Examination. A. N. ARNESON, M.D., St. Louis, Mo.

Diagnosis of Cancer of the Cervix. GERALD H. GALVIN, M.D., Baltimore, Md. (by invitation).

Spread of Cancer of the Cervix. ERLE HENRIKSEN, M.D., Los Angeles, Calif. (by invitation).

Classification of Cancer of the Cervix. GERALD A. GALVIN, M.D., Baltimore, Md. (by invitation).

Surgical Treatment of Cancer of the Cervix. ERLE HENRIKSEN, M.D., Los Angeles, Calif. (by invitation).

Radium Treatment of Cancer of the Cervix. JAMES F. NOLAN, M.D., Los Angeles, Calif. (by invitation).

Roentgen Treatment of Cancer of the Cervix. GILBERT H. FLETCHER, M.D., Houston, Texas (by invitation).

BANQUET: 7:00 P.M.

Hotel Statler

Friday, December 9

GENERAL SESSION: 10:15 A.M.

NEW TRENDS IN RADIOLOGY CORRELATED WITH RESEARCH IN OTHER SCIENTIFIC FIELDS

Richard H. Chamberlain, M.D., Philadelphia, Penna. Presiding

Perspectives in Biological Research. DAVID R. GODDARD, Ph.D., Philadelphia, Penna (by invitation).

Induced Radiation Mutations in Mammals. DONALD R. CHARLES, PH.D., Rochester, N. Y. (by invitation).

The Significance of Recent Developments in Tumor Chemotherapy. RALPH JONES, JR., M.D., Philadelphia, Penna. (by invitation).

Developments in Electronic Amplification of the Fluoroscopic Image. W. EDWARD CHAMBERLAIN, M.D., Philadelphia, Penna.

New Trends in Radiographic Screening Technics Utilizing Schmidt Optical Systems and High Speed Development. RUSSELL H. MORGAN, M.D., Baltimore, Md.

Developments in Cerebral Angiography. WENDELL G. SCOTT, M.D., St. Louis, Mo.

GENERAL SESSION: 2:00 P.M.

NEW TRENDS IN RADIOLOGY CORRELATED WITH RESEARCH IN OTHER SCIENTIFIC FIELDS (continued)

Million Volt Beryllium Window X-Ray Equipment for Biophysical and Biochemical Research. E. DALE TROUT, Milwaukee, Wis. (by invitation), and W. T. HAM, Richmond, Va. (by invitation).

Beryllium Window Tubes Applied to Superficial Therapy. RICHARD H. CHAMBERLAIN, M.D., Philadelphia, Penna.

Radio-gallium, Its Possibilities as a New Tool in Radiology. H. C. DUDLEY, Commander, MSC, USN, Bethesda, Md. (by invitation).

The Photographic Monitoring of Stray X-Rays and Gamma Rays. REX B. WILSEY, PH.D., Rochester, N. Y.

Units and Dosimetry of Ionizing Radiations. G. FAILLA, PH.D., New York, N. Y.

Sublethal Gamma Ray Exposure in Military Missions and Civilian Defense. ROBERT R. NEWELL, M.D., San Francisco, Calif.

ANNUAL MEETING
CLEVELAND, DEC. 5–9, 1949
LADIES' PROGRAM

The Ladies' Program for the Thirty-fifth Annual Meeting of the Radiological Society of North America will begin with a luncheon and style show at one o'clock, Monday, Dec. 5, 1949, in the Pine Room of the Hotel Statler.

Tuesday an eleven-thirty brunch will precede a visit to Nela Park. This renowned laboratory and institute of lighting research is housed in the Exposition Building. Here the latest developments in household lighting and electric devices for domestic and commercial use are shown and demonstrated. The laboratory is the site of the "Electric Home of Tomorrow" or "Horizon House," where the newest ideas in home lighting, color, and indoor sunshine are practically and aesthetically displayed.

A trip to the Cleveland Museum of Art will begin Wednesday afternoon's program. In addition to the Museum's regular exhibits of medieval, oriental, and modern art, there will be a special exhibit, "American Painting in Our Century." The special loan exhibit from Venice, "A Statue of San Ludovic" by Donatello, will be at the museum at this time.

Following the museum tour, a tea will be given in the Allen Memorial Library. This medical library, one of the most modern and beautiful in the country, contains the famous Marshall Collection of Herbals and the Nicolaus Pol Collection of Incunabula and Early Medical Writings, as well as the Howard Dittrick Museum of Historical Medicine.

Since many of the visiting radiologists will wish to see the Medical Library, they may join the ladies at the tea for this closing event of the Ladies' Program.

Ladies' registration will continue through the meeting at the Statler Hotel Lobby registration desk, as well as at the main registration desk in the Public Auditorium, from Sunday afternoon, Dec. 4, through Wednesday morning, Dec. 7.

MRS. GEORGE L. SACKETT
Chairman, Ladies' Entertainment Committee

THE JOURNAL OF THE FACULTY OF RADIOLOGISTS

A new name has been added to the list of periodical publications devoted specifically to radiology with the appearance of the *Journal of the Faculty of Radiologists*, in July 1949.

The Faculty of Radiologists was formed in 1939 to encourage the study and improve the practice of radiology. As the body recognized by the British Government as representative of medical radiology, it believes that the time is opportune for the publication of a journal to make public its activities and to bring before practising radiologists authoritative articles on current advances and problems in clinical radiology.

The Editor of the new journal, which will appear quarterly, is Peter Kerley, M.D., F.R.C.P., F.F.R., and the Assistant Editors are F. Campbell Golding, M.B., Ch.M., F.R.C.P., F.F.R., and Frank Ellis, M.Sc., M.D., F.F.R. The publishers are John Wright & Sons Ltd., Bristol (London. Simpkin Marshall, Ltd.).

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

PHOTORADIOGRAPHY IN SEARCH OF TUBERCULOSIS. By DAVID ZACKS, M.D., Chief of Clinics, Massachusetts Department of Public Health. A volume of 298 pages, with more than 270 illustrations. Published by Williams & Wilkins Co., Baltimore, Md., 1949. Price $5.00.

THE DIAGNOSIS OF PANCREATIC DISEASE. By LOUIS BAUMAN, M.D., Formerly Assistant Professor of Clinical Medicine, Columbia University, and Assistant Visiting Physician to the Presbyterian Hospital, New York. With a Foreword by ALLEN O. WHIPPLE, M.D. A volume of 74 pages, with 10 illustrations and 24 tables. Published by J. B. Lippincott Co., Philadelphia, Penna. Price $5.00.

A DESCRIPTIVE ATLAS OF RADIOGRAPHS. AN AID TO MODERN CLINICAL METHODS. By A. P. BERTWISTLE, M. B., Ch.B., F.R.C.S.Ed. A volume of 622 pages, with 980 illustrations. Seventh edition, revised and enlarged. Published by the C. V. Mosby Co., St. Louis, Mo., 1949. Price $16.00.

SIXTH SEMIANNUAL REPORT OF THE ATOMIC ENERGY COMMISSION, July 1949. A volume of 204 pages. United States Government Printing Office, Washington, D.C., 1949.

Book Reviews

ATLAS OF ROENTGENOGRAPHIC POSITIONS. By VINITA MERRILL, while Educational Director, Picker X-Ray Corporation. In two volumes, 664 pages, with numerous illustrations. Published by C. V. Mosby Co., St. Louis, 1949. Price $30.00.

Vinita Merrill, a medical technician of many years experience, has compiled a practical atlas of the positions used in general radiography and dedicated it to x-ray technicians, for whose use it is intended.

Many of the positions which are described are not the usual routine ones but under certain conditions could be of great value. One misses, on first glance, a description of the electrical aspects and construction of the apparatus used in radiography, but considering the purpose of the book, this can hardly be considered a fault. The stress is designedly upon the anatomical and practical aspects of roentgen technic.

Each chapter discusses a different area of the body, such as the upper extremity, the lower extremity, the bony thorax. A general discussion of the various structures concerned, brief but adequate, introduces the chapter and is followed by a short discussion of the arrangement of the patient and the part to be studied. Accompanying photographs show the actual position of the part, the tube position, and the resultant roentgenogram. Exposure factors are not given. In the chapters devoted to examination of the internal organs a brief discussion of the physiology of the organ is presented.

A complete bibliography, carefully classified, is given at the end of each volume, as well as an index to the entire work. At the end of Volume I there is appended a glossary of anatomical and medical terms which should prove very useful to technicians.

This is a valuable addition to the literature on roentgen technic. The volumes are beautifully bound and the general format is excellent. The work should find a wide usefulness in every roentgenologic library.

BLAKISTON'S NEW GOULD MEDICAL DICTIONARY. A modern comprehensive dictionary of the terms used in all branches of medicine and allied sciences, including medical physics and chemistry, dentistry, pharmacy, nursing, veterinary medicine, zoology and botany, as well as medicolegal terms; with illustrations and tables. Editors: HAROLD W. JONES, M.D., LL.D. (Hon.), Colonel, U.S. Army, retired; NORMAND L. HOERR, Ph.D., M.D., Henry Willson Payne Professor of Anatomy, School of Medicine, Western Reserve University, Cleveland, Ohio; ARTHUR OSOL, Ph.G., B.Sc. [Chem.], M.Sc. [Chem.], Ph.D., Professor of Chemistry and Director of the Chemistry Department, Philadelphia College of Pharmacy and Science. With the co-operation of an editorial board and 80 contributors. A volume of 1,294 pages, with 252 illustrations on 45 plates, 129 in color. Published by The Blakiston Company, Philadelphia and Toronto, First Edition, 1949. Price $8.50.

The name Gould has been associated with a series of American medical dictionaries that have earned a reputation for accuracy, completeness, and scholarship over more than half a century. *A New Medical Dictionary*, published in 1890, was succeeded by *An Illustrated Dictionary of Medicine, Biology, and Allied Sciences* in 1894, *A Dictionary of Medical Terms* in 1904, and later *Gould's Medical Dictionary*, which since 1926 has gone through five editions. The latest addition to this distinguished company is *Blakiston's New Gould Medical Dictionary*. Though based upon its predecessor, this is an entirely new work, prepared under the direction of an editorial board which includes three physicians, a professor of chemistry, a professor of philosophy, and two medical librarians. In the imposing list of contributors, Radiology is represented by Dr. Harry Hauser of Western Reserve University.

One assumes that a dictionary published under reliable auspices will be accurate. He demands further that it be complete and usable. To achieve completeness within the bounds of a single volume, in these days of expanding nomenclature, is something of an achievement. The radiologist will naturally look for the terms of his own specialty, more particularly those which have come into recent use. He will in general not be disappointed. The omission of the *gamma roentgen* and of *priodax* is unfortunate, but the field of radioactive isotopes has been well covered and such terms as, *betatron, fission (atomic)*, and *half-life* have been included. It is to be assumed from this that the other specialities have fared as well.

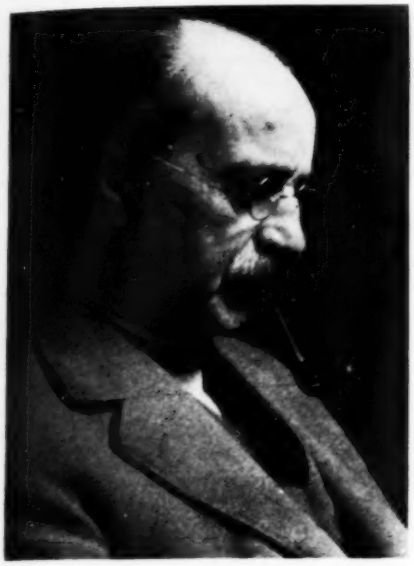
But however accurate or complete such a work may be, it falls short of its goal if it is not easily usable, by the physician who may consult it occasionally and by the editor who keeps it at his elbow for constant reference. The use of a boldface type and hanging indention have contributed much to this end. The items and sub-items stand out with almost startling clearness, while the division of the words into syllables is a boon in a busy editorial office. The definitions are clear and concise, alternative terms are given, with due attention to common usage, and there is a generous use of cross references.

A considerable number of biographical entries are included but the eponymic designation of diseases has been kept to a minimum. Thus, while there are entries under Kienböck's disease, Marie-Strümpell arthritis, and Albright's syndrome, these are limited to cross references to the biographical note or to a more descriptive name for the disease in question.

Special features of the work are the forty-five plates, many in color, grouped in the middle of the volume, and the appendix of tabular matter.

In their Preface, the editors lay much stress on the magnitude of this undertaking. They appear to have met competently the demands which it has made upon them. *Blakiston's New Gould Medical Dictionary* can be recommended to all who speak, read, or write in terms of medicine and its sister sciences.

In Memoriam



ALFRED ERNEST BARCLAY

1877–1949

The ranks of living pioneers of radiology are rapidly thinning, and it is with deep regret that we record the passing of another outstanding pathfinder in this specialty. On April 26, 1949, at the age of seventy-two years, Alfred Ernest Barclay came to the end of a long battle against the enemy which has engaged so much of the attention of radiologists since shortly after Roentgen's discovery. He himself made no secret of the gastric cancer for which he underwent several operations, including one for intussusception which followed shortly on pneumonia. These few words regarding his last illness briefly record an epoch of prolonged conflict which brought out all the courage and fortitude of which a human being could be capable—these he exhibited to the supreme degree.

The story of Alfred Barclay's life reads like a novel, of which we can offer only a short summary. Born in Manchester, England, he attended Leys School and Christ College at Cambridge. In 1900 he was enrolled in the London Hospital, where even as a student he was intrigued with the early use of x-ray. His qualification completed, in 1904 he became assistant Accident Room officer in the London Hospital and soon began to appreciate fully the possibilities for diagnosis, and especially for investigation, offered by the new rays. Like so many of the pioneers who accomplished much in radiology, Dr. Barclay had a degree in engineering, which undoubtedly gave him much assistance in his development of new equipment and diagnostic aids.

In his early work as a radiologist he was clinical assistant to Dr. Reginald Morton and to Dr. Sequeira, respectively, heads of the electromedical department, which at that time included the x-ray department and the skin department. In 1906, Dr. Barclay returned to Manchester and opened an office in conjunction with Dr. W. J. S. Bythell, with whom he wrote one of the earliest textbooks on x-ray diagnosis and treatment. In 1909 he organized and became director of the X-ray and Electrical Department in the new Manchester Royal Infirmary, and there laid the foundation, by experience and patient observation, for his important work on the gastrointestinal tract. He began his writings on the value of the x-ray in diseases of the digestive system in 1908, and within the next few years wrote prolifically on the normal and pathological stomach as seen with the x-ray, on some of the difficulties of gastric radiography, on the movements of the large intestine, on the detection of mastoid disease (1911), on the diagnosis of gastric and esophageal affections (1912). A monograph on radiography of the stomach and esophagus was published in London in 1913. There followed papers on hair balls in the stomach; gastric borborygmi; duodenal ulcer (1914 and 1915), radiological study of the large intestine, and in 1915 a new edition of his book on the alimentary tract.

During the First World War, Dr. Barclay ultimately found himself responsible for the x-ray service in hospital units totaling 35,000 beds. Because of the paucity of x-ray plates, the work was largely fluoroscopic. This war experience so impressed Dr. Barclay with the need of systematic training for x-ray work that in 1916 he began efforts to establish a chair in radiology at Cambridge University, which with the aid of Robert Knox, Stanley Melville, Sidney Russ, Elkin P. Cumberbatch, and others, resulted in 1920 in the establishment of the Cambridge Diploma in Medical Electrology and Radiology. Meanwhile, the Manchester Royal Infirmary had honored Dr. Barclay with an appointment to the Honorary Staff. His great interest in radiological teaching led him to leave Manchester in 1928 to carry on at Cambridge University in support of necessary training to qualify for this diploma.

This move to Cambridge typified the spirit of our friend. He left the city where he had made his home for twenty-two years and where he had achieved solid professional recognition (he was known as Barclay of Manchester) to take up residence in Cambridge, where the pecuniary reward was far from satisfactory but where he could give life to the diploma course and, in addition, take advantage of research privileges, which to him far outweighed any disadvantages. For nine years he continued at Cam-

bridge, building up the prestige of the diploma but denied the support which he requested for the development of a well equipped radiological department serving the other biological laboratories, which had been his dream. Meanwhile the Cambridge authorities deemed it wise to close the diploma course. But similar courses were now well established in other university centers, and an invitation was extended by Dr. K. J. Franklin—and accepted—to join him in the newly established Nuffield Institute for Medical Research at Oxford.

Here at last Barclay found himself with abundant help in both materiel and scientific personnel for carrying on the research work which was so deep in his thought. Radiologists are well aware of some of the research carried out in the Nuffield Institute by Barclay and his colleagues, especially in modifying existing cinéradiographic apparatus and in devising new equipment for working with animals in direct serial radiography. This equipment was applied to the study of the mechanism of dust excretion from the lungs and to cinéradiography of the circulation of sheep fetuses injected with thorotrast, the object of this latter work being to study the mode of closure of the ductus arteriosus. In addition, much information was gained regarding the process of transition from the fetal to the adult circulation.

This fruitful investigative work was interrupted by the Second World War. Dr. Barclay was appointed Adviser of Radiology to the Ministry of Health, and in this capacity organized the direction of the entire civilian x-ray service of his country.

The work of Trueta, already well known because of his surgical accomplishments during the Spanish Revolution, came within the field of Barclay's interest in 1940, when he was asked to assist in the study of the problem of uremia following extensive traumatism to the extremities. Little was done in actual research during the war years, but in 1945 the inquiry was started by cinéradiographic investigation of the renal blood flow. The studies were pursued devotedly, and the results, published in 1947, revealed a new biological approach to the study of the renal circulation. This investigation Barclay regarded as one of the most exciting and satisfying he had ever undertaken.

The idea of a shunting mechanism as a means of peripheral control of the circulation became very important; microradiography received much attention and aided much in the research both in regard to renal circulation and in connection with a discovery of a circulatory shunt mechanism in the wall of the stomach.

A few lines from a personal letter written just before the New Year of 1949, reveal the indomitable spirit of this extraordinarily courageous man:

"How few of the earlier workers are still taking an active part nowadays! One is a bit apt to cast back to long past days where the scene is peopled by so many friends who have passed on. That is a sign of old age. Personally I am so busy looking forward I have little time for retrospect. There are so many things I want either to finish or set in motion before the whistle blows and the game is over. But what a lot of fun we have had, we earlier workers who had to find our way in uncharted lands, and even now I find myself yearning beyond the skyline where the great roads go down—I want to lay the foundation for these roads, blaze the trails. Odd that one should have such a strong urge even when one's health and strength and age say that one ought to be quite content to be on the shelf.

"Since the war I've done little outside laboratory work.... One cannot keep up with all sides, especially if one spends half of one's time fighting pneumonias and abdominal operations. Odd that both Carman and I should have gastric carcinoma... Now I can only do an hour or so a day and then retire to bed.... but I really do things right well, all things considered, and get quite a spot of work done. You will see the gastric shunt in *Gastroenterology* for February and not very much later a book should come, nominally on technique of research but I have wandered philosophically into the vascular system as seen by microradiography with its far-reaching outlook, one that is basic to all research and should, I think, change a great deal of our ideas on physiology and pathology. The technique with the gastric shunt as a first fruit may be one of the most interesting and important things that is happening in modern physiology, according to John Fulton....

"We are going to Torquay for three months to get away from the climate of Oxford and I am taking a lorry load of apparatus to have a temporary laboratory there!"

In the United States, we saw much of Dr. Barclay. Especially do we remember his visit in 1937 in connection with the Fifth International Congress of Radiology. Few foreign radiologists were better known or more affectionately regarded in this country. He was an honorary member of the American Roentgen Ray Society, an honorary fellow of the American College of Radiology, and a corresponding member of the Radiological Society of North America. He was prominent, of course, in his associations with the British Dominions, where for years he represented the Australian and New Zealand Societies of Radiology on the Council of the British Institute of Radiology. Last year he was invited to deliver the first Sir Jagadish Bose Memorial Lecture in India. Although unable to attend, he sent his lecture and shortly before his death received the memorial gold medal.

Nor do we remember Dr. Barclay alone for his work. His devoted companion contributed largely to his ability in scientific investigations, and especially during the later years helped him to carry on. We offer our sincerest condolence. The American radiological organizations salute the memory of a great colleague and mourn with his friends that the end has come to such a useful existence.

JAMES T. CASE, M. D.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Harold Dabney Kerr, M.D., Iowa City, Iowa.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M D , 420 10th St., Tuscaloosa.

Arizona

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS. *Secretary*, R. Lee Foster, M. D., 507 Professional Bldg., Phoenix.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Wybren Hiemstra, 1414 S. Hope St. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, Charles E. Grayson, M.D., Medico-Dental Bldg., Sacramento 14. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. F. Reynolds, M.D., University Hospital, San Francisco 22. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Mark S. Donovan, M.D., 306 Majestic Bldg., Denver 2. Meets third Friday of each month, at the Colorado School of Medicine and Hospitals.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meetings bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John J. McGuire, M.D., 1117 N. Palafox, Pensacola. Meets in April and in November.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wm. W. Bryan, M.D., 490 Peachtree St., N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert Drane, M.D., De Renne Apartments, Savannah. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, John H. Gilmore, M. D., 720 N. Michigan Ave., Chicago 11. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Harold L. Shinall, M.D., St. Joseph's Hospital, Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*. William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Everett L. Pirkey, M.D., 323 East Chestnut St., Louisville 2.

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2. Meets second Friday of each month at Louisville General Hospital.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary-Treasurer*, George Belanger, M.D., Harper Hospital, Detroit 1. Meetings first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg., Minneapolis 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Charles J. Nolan, M.D., 737 University Club Bldg. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ralph C. Moore, M.D., Nebraska Methodist Hospital, Omaha 3. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston. Meets monthly on third Friday at Boston Medical Library.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Benjamin Copleman, M.D., 280 Hobart St., Perth Amboy. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, F. H. Ghiselin, M.D., 111 E. 76 St., New York.

QUEENS ROENTGEN RAY SOCIETY. *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3. Meets fourth Monday of each month.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, Ralph E. Alexander, M.D., 101 Medical Arts Bldg., Rochester 7. Meets at Strong Memorial Hospital, third Monday, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 1338 Second St., N., Fargo.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Paul D. Meyer, M.D., Grant Hospital, Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Seneca Hotel, Columbus.

CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Eugene L. Saenger, M.D., 735 Doctors Bldg., Cincinnati 2. Meets last Monday, September to May.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., Cleveland Clinic, Cleveland 6. Meetings at 6:30 P.M. on fourth Monday, October to April, inclusive.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Boyd Isenhart, M.D., 214 Medical-Dental Bldg., Portland 5. Meets monthly, on the second Wednesday, at 8:00 P.M., in the library of the University of Oregon Medical School.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., 1930 Chestnut St., Philadelphia 9. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22d St.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, R. P. Meader, M.D., 4002 Jenkins Arcade, Pittsburgh 22. Meets second Wednesday of each month at 6:30 P.M., October to June.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr. Next meeting in Denver, Colo., Aug. 18–20, 1949.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer* Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets during Annual Session of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. Meetings second Tuesday of each month at University Center.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frére, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meetings on third Monday of each month in Dallas in the odd months and in Fort Worth in the even months.

HOUSTON X-RAY CLUB. *Secretary*, Curtis H. Burge, M.D., 3020 San Jacinto, Houston 4. Meetings fourth Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Feb. 3–4, 1950, in Dallas.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Walker, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave. Milwaukee. Two-day meeting in May; one-day with State Medical Society, September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute, Madison 6.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542, Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, E. M. Crawford, M.D. Associate Honorary Secretary-Treasurer, Jean Bouchard, M.D. *Central Office*, 1535 Sherbrooke St., West, Montreal 26, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origéne Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Breast

The Chest

The Digestive System

The Musculoskeletal System

Gynecology and Obstetrics

The Genito-Urinary System

RADIOTHERAPY

RADIOACTIVE ISOTOPES

RADIATION EFFECTS; EXPERIMENTAL STUDIES

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Recognition and Treatment of Increased Intracranial Pressure in Infancy and Childhood. Barnes Woodhall. Pediatrics **2:** 533–543, November 1948.

The classical symptoms and signs of increased intracranial pressure may be recognized in the adult with a fair degree of accuracy. They consist, briefly, of headache, vomiting, papilledema, and a depressed or altered state of consciousness. They appear in the presence of any expanding lesion, be it brain tumor, traumatic hematoma, or chronic infection, because of the relatively simple fact that the adult skull may be considered a closed box, incapable of significant expansion in terms of relief of intracranial hypertension. In the infant and child, on the other hand, the skull is an expansible box rather than a closed one. The normal roentgenogram of the infant skull may therefore be expected to show definite differences from that of the adult, differences which are significant in the neurosurgical search for evidence of increased intracranial pressure.

In the infant, the bones of the skull appear homogeneous, since they are without a diploic structure and contain less inorganic material than in the adult. The bones are thin and fail to exhibit vascular markings and irregular areas of rarefaction or density characteristic of the adult roentgenogram. Suture lines, being composed of fibrous tissue, are well marked and wide. The sella turcica is roughly circular, smaller than that of the adult, and shows a blunt dorsum sellae. At the age of ten months the characteristics of the infant skull are still obvious. At the age of two years, a diploic structure appears and the roentgenogram begins to approach that of an adult. The bones of the skull gain adult thickness slowly, and a striking manifestation of the growth curve of the child's brain is apparent as a mottled irregularity on the inner surface of the skull. These areas, corresponding to the convolutions of the growing brain, are known as digital or convolutional markings. They may be irregularly distributed or localized. Within certain limits, they must be regarded as normal findings in the skull of the growing child.

It was found in a study of 100 children with verified brain tumors that in the majority of cases clinical signs and symptoms appeared in almost a fulminating fashion. One may infer from this that the compensatory mechanism of skull expansion prevents subjective distress during the early phase of increasing pressure and that symptoms develop only when intracranial pressure is well advanced and the compensatory mechanism has failed.

The types of initial complaint in this series were almost equally divided between those suggesting a reaction to intracranial hypertension and those denoting a specific neurologic defect. Thus 49 children had headache, vomiting, or an enlarged head as the initial complaint, while in 31 a staggering gait or an extremity paralysis was the initial symptom. A large percentage showed the syndrome of headache, vomiting, and disturbance of vision that is so characteristic of intracranial pressure. Since a large proportion, perhaps 70 per cent, of intracranial tumors in children involve the cerebellum or brain stem, the complaints of staggering gait and cranial or peripheral motor weakness might well be expected.

The neurologic examination of a child suspected of having a brain tumor may be divided into a search for evidence of intracranial hypertension and an evaluation of the existing neurologic defect. In the present series, 88 per cent showed indisputable evidence of increased pressure on simple ophthalmoscopic examination of the eyegrounds. An enlarged head and the so-called cracked-pot sound on percussion were present in a significant number of patients.

When the plain or routine roentgenograms of the skulls of these patients were studied, it was found that the diagnosis of a neoplasm could be suspected if not proved in 63 per cent. Films in cases in which the cracked-pot sound is elicited almost invariably show distinct separation of the suture lines. This may be seen in lateral views of the skull where the coronal suture line is commonly more affected and in anteroposterior views where the sagittal, rather than the lambdoidal, separates more widely. One would expect perhaps that the various x-ray signs of increased pressure would appear simultaneously in every patient. This is not the case, however, due to age differences and to variations in the degree of pressure, the thinness of the skull, the fibrous fixation of the suture lines, and the presence or absence of ventricular hydrocephalus.

In spite of the title of the paper, the treatment of increased intracranial pressure is not discussed.

Eleven illustrations, including 5 roentgenograms; 2 charts.

Relief of Symptoms Following Encephalography by Combined Premedication and Use of Oxygen. Carl J. Kornreich. Arch. Neurol. & Psychiat. **60:** 512–519, November 1948.

It has been shown by previous studies (Schwab, Fine, and Mixter: Arch. Neurol. & Psychiat. **37:** 1271, 1937) that inhalation of oxygen following encephalography results in prompt removal of most of the injected air from the subarachnoid space. This, of course, eliminates the severe postencephalographic headache, which may last in some cases for several days. The author achieved this result with an ordinary hospital oxygen tent. In 40 cases, 95 per cent oxygen was administered at a rate of 8 liters per minute. The patients were left in the oxygen tent for various periods, but three hours appeared to be adequate. In 28 patients treated for that length of time the results were excellent.

[The principle involved in this procedure is not new; it is based on lowering the amount of nitrogen in the blood by inhalation of pure oxygen, thus allowing rapid absorption of the nitrogen in the ventricles and subarachnoid spaces. The oxygen is no problem, since every capillary contains blood capable of taking up some oxygen, especially at the venous end.]

A study was also made of various types of premedication. A combination of hexobarbital (evipal) and a preparation containing both hexobarbital and aspirin (evicyl) was most effective in minimizing shock and vomiting and allaying the patient's fears.

Four roentgenograms; 1 drawing.

Zac. F. Endress, M.D.
Pontiac, Mich.

Air Embolism Occurring During Encephalography. Report of Two Cases. Arthur B. King and Frank J. Otenasek. J. Neurosurg. **5:** 577–579, November 1948.

The only 2 cases of air embolism occurring during encephalography over a thirty-year period at the Johns Hopkins Hospital are reported. Both injections were made by house-officers with more than average experience on the Neuro-Surgical Service and it is therefore known that neither an excess of air nor an excess of pressure was used during the procedure.

The site at which the air entered the vascular tree could not be determined postmortem in either case. Since no blood flowed out of either of the lumbar puncture needles when they were inserted, it seems very unlikely that any of the epidural veins in the lumbar region were entered. This possibility, however, cannot be entirely excluded. There were no abnormal vessels along the cauda equina that could have been punctured. The more probable explanation would seem that a small vein entering one of the dural sinuses in the head was broken, allowing ingress of air into the venous system. This, however, could not be proved.

Cerebral Angiography in the Diagnosis of Intracranial Hematomas. Kristian Kristiansen. Surgery **24:** 755–768, November 1948.

It is extremely important in cases of head injury to make the correct decision as to whether, when, and where to operate. In the author's experience the best guide is the state of consciousness. If a patient is regaining consciousness, operation is not believed to be indicated—regardless of evidence of a depressed skull fracture, slow pulse, increased blood pressure readings, etc. On the other hand, increasing drowsiness with restlessness, fading into stupor and coma, are clear indications for surgery. This picture may be present in cases of extradural, subdural, or intracerebral hematoma or of cerebral contusion and laceration with edema.

Percutaneous cerebral angiography will differentiate these various conditions and, at least theoretically, should detect combined intracerebral and subdural hematomata. The author claims that no harm results from the procedure in acute head injuries.

Careful observation of the patient and conservatism in performing the indicated surgery are stressed.

Six cases are reported but unfortunately all of the illustrations but one are line drawings of the films. It would be interesting to see the quality of the roentgenograms obtained in this type of case.

One roentgenogram; 12 drawings; 3 photographs.

ZAC. F. ENDRESS, M.D.
Pontiac, Mich.

Case of Basilar Impression Associated with Cerebral Tumour. Jeffery R. Tripp and R. D. Rothfield. M. J. Australia **2:** 519–523, Oct. 30, 1948.

Basilar impression is a deformity of the occipital bone associated with narrowing of the foramen magnum and of the cervical canal, giving rise to progressive compression of the spinal cord, medulla, and cerebellar hemispheres. The authors discuss the causes, clinical features, and diagnosis, which can be made by the characteristic x-ray appearance of the skull.

No record of basilar impression associated with intracranial neoplasm could be found in the literature, and for this reason the authors present the following case.

The patient was a 17-year-old girl with the onset of headaches two years prior to her admission to the hospital. Multiple neurological symptoms had subsequently developed, including staggering with falling to the left, a right-sided facial palsy, and the recent onset of diplopia. The physical, laboratory, and x-ray findings are described. Though the posterior border of the tumor is clearly seen in the ventriculogram, it was overlooked, and the diagnosis was limited to basilar impression. The observers felt that surgery for decompression of the posterior fossa was indicated. Subsequent to the operative procedure, the patient expired. The autopsy findings are described.

It is suggested that the basilar impression may have developed secondary to the tumor and its associated hydrocephalus and increased intracranial pressure. The possibility that the two conditions of basilar impression and primary tumor were unrelated is also considered.

Nine illustrations, including 2 roentgenograms.

D. R. BRYANT, M.D.
The Henry Ford Hospital

Case of Localized Osteitis Fibrosa of the Skull. Margaret Leslie and David Stenhouse. Brit. J. Surg. **36:** 211–212, October 1948.

The rarity of localization of osteitis fibrosa in the skull justifies the reporting of this single case. Preoperative x-ray studies showed a bony swelling in the left upper parietal region with elevation and thinning of the outer table and marked expansion of the diploe over a circumscribed area. No intracranial extension was present.

Microscopic examination of the area after removal showed the usual changes of osteitis fibrosa and blood chemistry studies were found to be normal. Thus the diagnosis is well established.

The films are interesting in that they seem to be characteristic; at least, they resemble no other condition closely.

Three roentgenograms; 2 photographs; 1 photomicrograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Penetrating Injury of the Cranial Vault. John Hunter and Gilbert Phillips. Australian & New Zealand J. Surg. **18:** 140–143, October 1948.

A case is reported illustrating the severe intracranial disturbance which may follow an apparently minor wound of the scalp unaccompanied by signs of concussion or cerebral damage. The extent of the external wound to the head is often no indication of the degree of trauma suffered by the brain.

A laborer aged 29 years sustained a head injury caused by a falling tool, while working in a caisson. There was no loss of consciousness, and he was able to stand and walk. Skull films were reported as negative. A small scalp laceration was noted at the vertex. The next two weeks were not eventful except for slight sluggishness and headache. Sixteen days following the injury, however, progressive paresis of the right upper and lower extremities developed. Further examination showed early papilledema in the left fundus and abnormal reflexes on the right side. Repeat roentgenograms revealed a depressed fracture of the left parietal bone near the vertex, with a number of depressed bone fragments. At operation the dura was found to have been lacerated and driven into the cortex. The skull defect and involved brain were debrided, and a small abscess

localized in the brain and another in the subdural space were drained, all bone fragments were removed, and the wound closed. Postoperative electroencephalography showed satisfactory results, and complete recovery, except for a slight residual limp, ensued.

A plea for early x-ray studies in supposedly minor scalp wounds, even with no alteration of the conscious level, is made. Depressed skull fracture constitutes an indication for immediate surgical removal of indriven bone fragments.

Two roentgenograms; one photograph; two electroencephalograms. EDWARD E. LEVINE, M.D.
Dearborn, Mich.

Examination of the Nasal Accessory Sinuses by Filling with Contrast Medium. K. Graf. Schweiz. med. Wchnschr. **78:** 1123–1125, Nov. 20, 1948. (In German)

After a brief general discussion of the indications for and value of contrast filling of the sinuses, especially the antrum, for radiographic study, Graf strongly advocates the use of a barium sulfate suspension instead of the usual iodized oil. He cites as advantages the better delineation, the greater ease of filling, since the suspension runs readily through a needle, and a marked saving in expense. He prefers to remove the contrast substance after the examination for fear of exacerbation of any infection present.

Four roentgenograms. LEWIS G. JACOBS M.D.
Oakland, Calif.

THE BREAST

Localization and Treatment of Papillomas of the Breast. Harry C. Saltzstein and Robert S. Pollack. Cancer **1:** 625–633, November 1948.

What to do with the patient who occasionally bleeds from the nipple in the absence of a palpable tumor is a perplexing problem and much disagreement exists on the extent of surgical treatment necessary for proper handling of the condition. Many recommend amputation, but good statistics are available to show that cases may frequently be conservatively treated, especially in the absence of a palpable tumor.

Four types of bleeding from the nipple should be considered: (1) bleeding occurring with a large, hard, palpable mass clinically resembling cancer; (2) bleeding occurring with a mass more characteristic of chronic mastitis; (3) bleeding from a small palpable tumor in the periphery of the areolar region; (4) slight bleeding from the nipple in the absence of a palpable tumor. This last type presents a problem in diagnosis for which mammography may be used. Too often mastectomy is recommended and done for a benign condition.

Eight cases of papilloma of the breast are reported and analyzed. Appropriate film studies and photographs of gross specimens are included for illustration.

CHALMERS S. POOL, M.D.
University of Arkansas

THE CHEST

Conditions to Be Differentiated in the Roentgen Diagnosis of Pulmonary Tuberculosis. L. H. Garland. Ann. Int. Med. **29:** 878–880, November 1948.

This paper consists largely of a list of 89 diseases, disorders, and anomalies which may resemble pulmonary tuberculosis in the roentgenogram, that is, which may cast shadows identical with those cast by pulmonary tuberculosis in its various forms. In his twenty-one years of radiologic practice, the author has seen all but four of the conditions (blastomycosis, pulmonary phleboliths, bagassosis, eosinophilic granuloma) confused with pulmonary tuberculosis or miscalled pulmonary tuberculosis. Authenticated cases are available in the literature in which these four also were the source of erroneous diagnoses of tuberculosis.

Apical Pulmonary Carcinoma and Tuberculosis: The Value of Sputum Cell Study in Differential Diagnosis. Martin Bergmann, Burton A. Shatz, and I. Jerome Flance. J. A. M. A. **138:** 798–801, Nov. 13, 1948.

Examination of the sputum for tumor cells will yield a positive diagnosis in from 60 to 88 per cent of carcinomas of the lung. Three cases are presented in which a diagnosis of cancer was thus established when tuberculosis was suspected on the basis of the clinical and roentgen findings. Bronchoscopy failed to provide positive biopsies, but in each case the nature of a right upper lobe lesion was revealed by the finding of neoplastic cells in the sputum.

In the authors' experience the incidence of tumor cells in the sputum has been highest in lesions of the upper lobes of the lungs, probably because of the better drainage of bronchial secretions from the upper lobes into the main bronchi, where they are readily expectorated. Thus, in the very cases in which bronchoscopy is oftenest of no help the sputum examination is most likely to give positive results. In the older age groups especially, sputum examination for neoplastic cells should be employed almost as routinely as the examination for tubercle bacilli in the diagnosis of apical pulmonary lesions.

Three roentgenograms; 3 photomicrographs.
M. M. FIGLEY, M.D.
University of Michigan

Difficulties in Diagnosis Between Tuberculosis and Loeffler's Syndrome. C. S. Barker and J. A. Fownes. Canad. M. A. J. **59:** 472–474, November 1948.

The authors report a case which they believe serves to emphasize the difficulty in differential diagnosis between pulmonary tuberculosis and Loeffler's syndrome. The patient was an eighteen-year-old white male, with a history of recurrent asthmatic attacks. X-ray examination revealed areas of transitory pulmonary infiltrations which could not definitely be ascribed to tuberculosis or Loeffler's syndrome. Tuberculin tests and studies of the sputum and stomach washings were repeatedly negative. The eosinophil count varied between 3 and 22 per cent. A definite diagnosis was not established. Additional progress notes revealed further regression of the parenchymal changes and the tuberculin test remained negative.

Four roentgenograms; 2 tables.
ROBERT H. LEAMING, M.D.
Jefferson Medical College

The Homolaterality of Pulmo-Laryngeal Tuberculosis. E. Stangl. Schweiz. med. Wchnschr. **78:** 1106–1111, Nov. 13, 1948. (In German)

Most authorities believe that the development of laryngeal tuberculosis as a complication of pulmonary tuberculosis is accomplished by spread along the tracheobronchial tree, although occasional essayists have

suggested the blood or lymph channels as possible routes of spread. Stangl studied 100 cases in which this complication was present, and found that in 44 the disease was on the same side as the pulmonary lesion, in 18 on the opposite side, and in 36 the laterality was indeterminate for various reasons (advanced disease, etc.). This preponderance of homolaterality leads him to believe that the usual route of spread is hematogenous, with a neurologic component permitting ready blood flow from the primary lesion to the larynx. He therefore speaks of a "neurohematogenous" origin for the laryngeal component of the pulmolaryngeal complex.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Tuberculosis Case-Finding Survey in Penal and Correctional Institutions in Ohio. Mark W. Garry. Dis. of Chest **14:** 862–869, November-December 1948.

Chest surveys were made, with 35-mm. film, of the inmates and employees of two penal and two correctional institutions for males in Ohio in 1946. Reexaminations with 14 × 17-inch films were made when evidence of disease was detected. Of 7,123 inmates, 237, or 3.3 per cent, showed tuberculosis, as follows: minimal 126, moderately advanced 71, far advanced 13, primary 1, reinfection 15, pleurisy with effusion 3, unclassified 8. Of 640 employees, 15, or 2.3 per cent, showed tuberculosis: minimal 4, moderately advanced 3, far advanced 1, reinfection 2, unclassified 4, silicosis with infection 1. The 237 cases detected among the inmates represent an incidence of 33 per thousand, which is three times greater than that in the general population. The 15 cases detected among the employees represent an incidence of 23 per thousand, which is twice that found in community surveys.

The author does not give the number of known and the number of newly detected tuberculosis cases in this survey.

Unsuspected non-tuberculous disease was found in 95, or 1.2 per cent of the screened cases.

Recommendations are made for a program of tuberculosis control for the penal and correctional institutions of the state (see also Horst and Beatty: Ohio State M. J. **43:** 825, 1947. Abst. in Radiology **51:** 129, 1948).

Four tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Streptomycin Treatment of Pulmonary Tuberculosis. A Medical Research Council Investigation. Brit. M. J. **2:** 769–782, Oct. 30, 1948.

A planned group investigation was carried out under the auspices of the British Medical Research Council in the hope of obtaining a negative or affirmative answer to the question, "Is streptomycin of value in the treatment of pulmonary tuberculosis?" It was not designed to determine in what types of pulmonary tuberculosis streptomycin could be effective, nor to determine optimal dosage or duration and rhythm of treatment.

One hundred and seven patients with acute progressive bilateral tuberculosis unsuitable for collapse therapy were studied. Fifty-two patients were treated with bed rest alone and 55 were treated with bed rest and streptomycin. The period of observation for each patient was six months. At the end of that period 7 per cent of the streptomycin patients and 27 per cent of the bed rest patients had died.

Radiologically considerable improvement was noted in 51 per cent of the streptomycin patients and 8 per cent of the bed rest patients; slight or moderate improvement was noted in 18 per cent of the streptomycin patients and 25 per cent of the bed patients; apart from those who died, deterioration was seen in 18 per cent of the streptomycin patients and 34 per cent of the bed patients.

Improvement in streptomycin patients was greatest in the first three months. After the end of this period, many began to deteriorate.

At the end of six months, examinations for tubercle bacilli were negative in 8 streptomycin cases and 2 bed rest cases. The best results in streptomycin cases were seen in the first months of treatment.

Tests for streptomycin sensitivity of infecting strains were made in 41 cases, and the authors attribute much of the deterioration seen after initial improvement to streptomycin resistance.

Twenty roentgenograms; 14 tables; 6 charts.

JOSEPH D. CALHOUN, M.D.
University of Arkansas

Asbestosis: VI. Analysis of Forty Necropsied Cases. Kenneth M. Lynch and W. M. Cannon. Dis. of Chest **14:** 874–885, November-December 1948.

This is one of a series of papers on asbestosis of which the first was published in 1930. In the eighteen years covered by these studies some degree of asbestosis was encountered in 40 autopsies. Upon the basis of the degree of pulmonary fibrosis, 12 of these cases were considered as of minor grade, 14 medium grade, and 14 advanced. The cases of minor grade were incidental findings in patients dying of other disease. Nor was there any evidence that asbestosis of medium grade was responsible for death; in these cases the history of employment in an asbestos factory was usually traced only after the necropsy diagnosis had been made. The shortest known exposure in this group was twenty-eight months in a three-year period. In at least 4 of the 14 cases of advanced degree, pulmonary fibrosis played a major role as a cause of death.

An "asbestosis" body consists of a central asbestos fiber with a shiny yellow-brown coating, appearing in a variety of architectural forms. These bodies are usually located in the terminal bronchioles and in the vestibular area of the lobule. Small ones may appear in the peribronchial lymph nodes, where there is a foreign-body reaction, but usually little if any fibrosis. The bodies remain in the lungs more or less permanently and undergo slow but definite changes. The finding of asbestos bodies in the sputum is only an indication of exposure, and gives no information as to the condition of the lungs. Asbestos bodies are usually more numerous in cases of current or recent long exposure, but may be found for years after cessation of exposure. They may even be absent or present in only sparse numbers in advanced asbestosis of long duration.

Pleural thickening is a feature of advanced asbestosis, though it is not invariably present. These were 16 cases of the present series in which there was no pleural fibrosis, including 6 in the advanced stage. In 16 cases there was other pulmonary disease which may have been responsible for the fibrotic changes in the pleura.

In association with the pulmonary fibrosis the authors found hyaline nodules of scar tissue in 8 instances. In this connection they quote King, Clegg, and Rae (Thorax **1:** 188, 1946), who observed nodular fibrosis of the lung following intratracheal injection, in rabbits, of

asbestos fiber of 15 or more microns in length while diffuse fibrosis resulted from similar injection of fibers measuring 2.5 microns.

Carcinoma of the lung was found 3 times in this autopsy series, an incidence of 7.5 per cent compared to a general incidence of 1 per cent in 2,683 necropsies in the last ten years.

The authors found no evidence that asbestosis favors the development or progression of tuberculosis. Only 4 cases of active tuberculosis were found.

In general, the advance of the disease and the age of the lung fibrosis parallel the duration of exposure and the length of time since its beginning. Fibrosis does not progress indefinitely after exposure ceases, but that existing persists, aging into scar tissue.

In the discussion of this paper Dr. Leopold Brahdy emphasized the necessity of establishing an etiologic or non-etiologic relationship between tuberculosis and asbestosis and of correlating the length of exposure and the severity of the disease. Dr. W. Bernard Yegge emphasized the differences between pulmonary asbestosis and silicosis. Asbestosis is caused by an alkali, magnesium silicate, along with calcium and iron; the particles are arrested in the bronchioles and alveoli and are not readily transported into the lymphatic system; the sputum contains asbestos bodies. Early in the disease the roentgen appearance may be similar to silicosis, but in more advanced asbestosis a ground glass opacity and involvement of the costophrenic angles are distinguishing features.

Six illustrations; 3 tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Hemp Pneumoconiosis. Giano Magri. Radiol. med. (Milan) **34:** 668–682, November 1948. (In Italian)

The author has studied forty patients who, after working many years in factories where the air was laden with hemp dust, suffered from persistent cough and dyspnea, some emphysema, and allergic manifestations. The radiologic appearance of the chest is not characteristic but shows emphysema, widening of the hilar shadows, and increase of the pulmonary markings. The symptoms and radiologic changes become apparent only after a prolonged exposure to the dust, and the affection is relatively benign.

Three roentgenograms.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Bronchostenosis of Inflammatory Origin, with Report of Six Cases. H. F. Fabritius and H. Ødegaard. Acta radiol. **30:** 385–394, Nov. 30, 1948.

The authors state that the most common cause of atelectasis is bronchial obstruction, which they classify as follows: (1) obstruction of the lumen (blood, secretion, foreign body); (2) changes in the bronchial wall (inflammatory or due to tumor); (3) extrabronchial changes with compression of the lumen. They report 6 cases of bronchial stenosis caused by inflammation in the bronchial wall.

In all the cases there was a long history of bronchitic symptoms with expectoration—two to twenty-six years; in 2 there was hemoptysis. In 3 cases the stricture was due solely to non-specific inflammation, and in 1 to a local inflammation around a foreign body. In the 2 remaining cases tubercle bacilli had been demonstrated on single occasions. In one of these a lobectomy was performed and histologic examination showed no evidence of specific inflammation; in the other tubercle bacilli could not be demonstrated by direct smears or cultivation over a three-year period.

The authors emphasize that a chronic bronchitis may mask a bronchostenosis caused by localized inflammation in a bronchus. Only slight changes may be present on the usual chest roentgenogram. In 4 of their cases, the constriction was demonstrated by planigrams, and in 4 by bronchography (including the 2 in which planigrams were not obtained). Bronchoscopy with biopsy was done in all six cases.

Treatment is not discussed in detail. Both medical management and lobectomy were employed in the reported cases.

Fifteen roentgenograms. W. H. ROBINSON, M. D.
Cleveland Clinic Foundation

Adamantinoma of the Maxilla Metastatic to the Lung. Orville F. Grimes and H. Brodie Stephens. Ann. Surg. **128:** 999–1005, November 1948.

Adamantinoma is a rare, slow growing epithelial tumor of the jaw, which is related to the dentigerous cyst and might well be called an enamel-cell tumor. It is usually benign but metastases have been reported in 18 cases. In 9 of these the pulmonary parenchyma was involved but only in 2 was the diagnosis proved histologically. The authors report a third case.

Sixteen months prior to admission, the patient had a radiographic examination of the chest which showed a soft shadow in the right lung field, interpreted as bronchitis. A slight irritative cough without production of sputum or blood persisted to the time of entry. Repeat roentgenograms at ten months and one year after the original examination showed an increase in the size of the lesion.

Ten years previously an adamantinoma of the left maxilla had been removed surgically, and postoperative radium therapy had been given, with eventual partial ankylosis of the temporomandibular joints, which prevented bronchoscopy at the time of examination.

Roentgenograms of the chest on admission showed a circumscribed density of the lower lobe of the right lung in the posterior basal division. Comparison with the previous studies indicated further increase in size of the lesion.

At operation a hard, circumscribed, rounded mass was found deep in the parenchyma of the right lower lobe and was entirely confined within it. The hilar and mediastinal nodes were soft and not grossly involved. Therefore, a lobectomy was performed. The patient responded well postoperatively.

The microscopic appearance of the tumor was interpreted as adamantinoma carcinoma. The similarity in appearance to the original sections of the tumor of the maxilla was very striking.

Four illustrations, including 2 roentgenograms; 1 table. BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Hereditary Hemorrhagic Telangiectases Associated with Pulmonary Arteriovenous Fistula in Two Members of a Family. John H. Moyer and Alfred J. Ackerman. Ann. Int. Med. **29:** 775–802, November 1948.

Two cases of hemorrhagic hereditary telangiectases with associated pulmonary arteriovenous fistula are

reported. The patients were brothers. Their father had had numerous telangiectases of the face and lips and their two brothers and two sisters all exhibited cutaneous and mucocutaneous telangiectases.

Hereditary telangiectases occur most commonly on the skin and mucous membranes, but may involve any organ. The cutaneous or mucosal vascular lesions are composed of dilated small vessels which histologically comprise a single layer of endothelium beneath a much thinned layer of epithelium. The absence of muscular and elastic layers of the vessel wall is conspicuous. The vessels are fragile and rupture easily.

While visceral involvement in association with hereditary hemorrhagic telangiectasis is well known, pulmonary lesions have been rarely recognized. The authors were able to find only 3 cases in the literature.

The roentgen findings in arteriovenous fistula, or cavernous hemangioma, of the lung have been described by Lindgren (Acta radiol. **27:** 585, 1946. Abst. in Radiology **50:** 262, 1948) and are confirmed by the authors' observations. Circumscribed, slight lobulated shadows of increased density are observed in the lung. Occasionally the lesions are multiple and bilateral. The intrapulmonary opacities are connected with the hilar vessels by broad, tortuous bands of increased density, representing a distended branch of the pulmonary artery and a dilated pulmonary vein, both of which open into a tumor-like vascular sac. Usually two such vessels are observed, but in some instances more anomalous vessels have been encountered. The communicating vessels lie in different planes, and it is usually necessary to obtain films in several projections to demonstrate the anatomical relations of the vessels and the tumor produced by this abnormality. Fluoroscopic examination may reveal pulsations of the tumor, and slight variations in its size may occur, depending on change of the intrathoracic pressure. The significance of pulsations of tumors must be carefully evaluated. It is difficult to differentiate definitely between spontaneous and transmitted pulsations, particularly when a tumor is located near the hilus and only a part of the circumference of the mass can be demonstrated. The pulsation of peripherally located lesions can be proved more readily by appropriate kymographic studies.

The radiologic diagnosis may be quite difficult. Small cysts, adenomata, metastatic lesions, and tuberculomata are some of the lesions offering differential problems. Aneurysms of the branches of the pulmonary artery may also cause round opacities. Intrapulmonary hemorrhages resulting from a rupture of the dilated vessel occasionally cause irregular densities and even segmental atelectasis, obscuring the primary lesion and thereby adding to the diagnostic difficulties.

The routine radiologic examination can be advantageously supplemented by body-section radiography and angiography. Angiography, when successful, demonstrates clearly the vascular character of the tumor, and its connection with the pulmonary vessels. Special caution must be exercised, however, in the performance of this procedure. Because of the high cell volume associated with this disease, thrombosis is a real danger. Intravenous injection of 70 per cent diodrast is preferable to introduction of the dye after catheterization.

Congenital pulmonary arteriovenous fistulae are not always single lesions. There may be small subpleural "hemangiomata" in close contact with the structures of the thoracic cage, which easily escape radiologic detection on routine examination. It is essential to obtain several films, in various projections, in order to demonstrate the pleural surface of the lung, along most of its circumference. A better visualization of the "hemangiomata" can be obtained on deep inspiration followed by forced expiration against the closed glottis (Valsalva test), and the exposures should preferably be made under those conditions.

Symptomatic arteriovenous fistulae necessitate surgical intervention. Total pneumonectomy, lobectomy, or partial resection of a lobe has been performed, depending on the findings ascertained on thoracotomy of individual cases. One of the authors' cases was cured by pneumonectomy.

Fifteen illustrations, including 8 roentgenograms; 4 tables. STEPHEN N. TAGER, M.D.
Urbana, Ill.

Case of Arteriovenous Aneurysm of the Lung Cured by Resection. Olaf Brøbeck. Acta radiol. **30:** 371-379, Nov. 30, 1948.

A case of arteriovenous aneurysm of the lung in a 34-year-old woman is reported. Polycythemia, clubbing of the fingers, and a known density in the chest had been present for thirteen years. Dilated and tortuous vessels were present in the left eye, and a systolic murmur was audible in the left axillary line.

On the postero-anterior chest film, a dense, well defined shadow was seen projecting several centimeters beyond the left cardiac border into the left lower lung field. With lateral and oblique projections, the density was placed anteriorly and appeared to communicate with the hilus. The findings were compatible with a diagnosis of arteriovenous aneurysm of the lung, though pulsations could not be determined either fluoroscopically or on kymography. Catheterization of the heart was carried out, and oxygen saturation determinations indicated that roughly two-thirds of the blood passing through the pulmonary artery was diverted from the respiratory organ.

At operation an aneurysm the size of an orange was found, originating from an artery in the lingula. It terminated in a "finger-thick" vein entering the inferior plumonary vein. Resection of the lingula with both the artery and the vein was accomplished. Examination of the operative specimen showed two large vessels running side by side for approximately 1 cm. The partition between them was gradually transformed into a narrower cribriform wall, and at last the two vessels joined in a large thin-walled cavity.

The postoperative course was uneventful and the patient was discharged as well two months later.

Five roentgenograms. W. H. ROBINSON, M.D.
Cleveland Clinic Foundation

The Lateravertebral Band: Its Significance. R. Sarrouy. J. de radiol. et d'électrol. **29:** 646-647, 1948. (In French)

It is common to observe, on roentgenograms of the thoracic spine, in the frontal view, a linear shadow bordering the left of the vertebral column; very rarely is such a shadow seen on the right. A cross section of the thorax at the level of the eighth thoracic vertebra helps to explain this. The left posterior mediastinal lung surface runs strictly anteroposteriorly,

while on the right its course is oblique, dorsolaterally, the difference being due to the presence of the descending aorta on the left. The shadow is explained by the law of Burnetti, that a linear surface viewed tangentially appears as a density on the roentgenogram. Differences in density between the pulmonary parenchyma and the osseous vertebrae contribute further to delineation of the shadow.

In Pott's disease of the spine there is progressive enlargment of this band. A perispinal hematoma or suppurative osteomyelitis gives an identical picture. Other conditions resulting in a thickening of the shadow are neoplastic metastases or lymphogranulomatoses, with proliferation around the involved vertebrae, and affections of the mediastinal pleural surface.

[For other views on this left paraspinal shadow, see papers by Garland and Brailsford. Radiology **41:** 29, 34, 1943.-Ed.]

Two drawings.

CHARLES NICE, M.D.
University of Minnesota

Pleural Effusion Simulating Elevated Diaphragm. John J. Cincotti, Stanton T. Allison, and John M. Nilsson. Am. Rev. Tuberc. **58:** 554–561, November 1948.

Pleural effusion may be so distributed as to simulate an elevated diaphragm. An illustrative case is reported and the literature is briefly reviewed. The roentgen appearance is that of a convex diaphragm-like contour which varies in degree of convexity, smoothness, and elevation. The cause of atypical distributions of pleural fluid is unknown. The fluid need not be encapsulated. Diagnosis may be difficult. The technic described by Rigler (see, for example, Am. J. Roentgenol. **25:** 220, 1931) is recommended, including films taken in lateral decubitus. If the fluid is encapsulated, diagnostic pneumoperitoneum may be necessary to show the true nature of the condition.

Nine roentgenograms.

L. W. PAUL, M.D.
University of Wisconsin

Cervicomediastinal and Mediastinal Cystic Hygromas. Robert E. Gross and Elliott S. Hurwitt. Surg., Gynec. & Obst. **87:** 599–610, November 1948.

Though approximately 225 cases of cystic hygroma of the neck are reported in the literature, only 19 cervicomediastinal and 9 mediastinal hygromas were found to be recorded. Details of these are tabulated, and 3 additional cases are presented, 2 of the cervicomediastinal type in young children and a mediastinal mass in an adult.

Cystic hygromas are classified among congenital malformations and are believed to be derived from the lymphatic sacs or buds developing from outpouchings of the venous system or from mesenchymal deposits, either of which may be pinched off, thus predisposing to cystic formation. The common sites are the cervical, axillary, and rarely the inguinal regions, corresponding to the normal areas of lymphatic buds in the embryo. The mechanism of the development of the cervicomediastinal and mediastinal types is not explained. Pathologically, these are thin-walled multilocular cysts containing thin colorless to xanthochromic fluid, lined by endothelium, and often showing connective tissue, fat, blood vessels, and nerves in their walls. During development the buds extend along tissue planes and may engulf anything in their path, with the result that they may be extremely difficult to remove without damaging essential structures.

Clinically, a soft, ill-defined swelling in the neck is usually noted at birth or shortly thereafter. Periodic fluctuations in the size of the cervical mass, with increase during crying, grunting, or expiration, and decrease during inspiration, are frequently observed. These changes are seen fluoroscopically as well as on x-ray films of the chest, which show the mass descending into the mediastinum during inspiration. The regional structures are displaced and may be mechanically compressed. When confined to the mediastinum, the cystic hygroma cannot be differentiated roentgenologically from other rounded shadows in this location.

The authors believe that these cystic lesions should be removed surgically, as extensively as possible. In cases of cervicomediastinal hygroma, a multiple-stage procedure may be necessary, the cervical portion being removed first, with subsequent thoracotomy for dissection of the intrathoracic portion. In other cases, following removal of the cervical component the dissection may be carried down through the thoracic inlet to remove the rest of the hygroma or a sclerosing agent may be introduced and drainage instituted, so that the irritated walls may remain collapsed and fuse.

While the authors advocate these methods of treatment, they call attention to the reports of Singleton (Ann. Surg. **105:** 952, 1937) and Goetsch (Arch. Surg. **36:** 394, 1938) on x-ray therapy of the mediastinal lesions after removal of the cervical mass, and to Portmann's favorable results with radon seeds (Cleveland Clin. Quart. **12:** 98, 1945).

Seven roentgenograms; 6 photographs; 6 photomicrographs; 2 tables.

ROY GREENING, M.D.
University of Pennsylvania

Angiocardiography Utilizing Photoroentgen Apparatus with a Rapid Film Changer. Harold L. Temple, Israel Steinberg, and Charles T. Dotter. Am. J. Roentgenol. **60:** 646–649, November 1948.

In 1938 the first practical method of angiocardiography was described. Since that time, numerous devices for obtaining rapid multiple exposures have been reported. In the apparatus described by the authors a fluoroscopic screen is mounted in a standard photoroentgen hood and a 70-mm. Fairchild roll-film camera, modified for a film transport time of one-half second, is attached. Exposures are timed by means of a Morgan-type phototimer. With a 200 ma. rotating anode tube, operated at 100 kv.p., exposures range from 0.1 to 0.4 second.

A case of aortic aneurysm, one of a presumably congenital aneurysm of the pulmonary artery, and one of hypertension are presented briefly as illustrative of the results obtained with this technic.

The authors feel that further development of the apparatus is possible and that, with the establishment of suitable standards, angiocardiographic measurements comparable to those made from the conventional teleoroentgenogram will be possible. The expense of operation is minimal, and with more widespread use, the cost of equipment will become moderate. With further improvement, it is believed that the method may become the standard procedure for angiocardiographic recording.

Six roentgenograms and a photograph of the apparatus.

P. B. LOCKHART, M.D.
Indiana University

Angiocardiography in Congenital Heart Defects. E. Rossi and A. Prader. Schweiz. med. Wchnschr. **78:** 1054–1064, Oct. 30, 1948. (In German)

Now that surgical correction is a possibility, it has become essential to investigate adequately all cases of possible congenital heart lesions. This is best accomplished by a team, consisting of both medical and surgical members. At the Children's Hospital of Zurich an order of procedure has been set up as follows:

1. Thorough clinical examination.
2. Electrocardiogram and phonocardiogram.
3. Hematologic examination.
4. Estimation of circulation time.
5. Standard roentgenologic study, without and with esophagrams.
6. Angiocardiography.
7. Cardiac catheterization with pressure determination and carbon dioxide saturation determination in the various chambers.

Angiocardiography was first undertaken at this institution in November 1947, and had been done in 40 cases up to the time of this report. The age range was from six months to adulthood. The contrast medium employed was either 70 per cent diodrast or the Swiss drug Ioduron, 70 per cent (Cilag). The dose varied from 10 to 15 c.c. for infants to 50 c.c. for children over fourteen years. To secure proper filling of the cardiac chambers it is imperative to inject the drug in one or two seconds, which is accomplished by the use of a large (18–20) needle. Injection into the internal jugular vein leads to somewhat better films. As a rule, the studies were conducted with the patient recumbent, exposures being made as rapidly as possible, with a homemade tunnel. No serious reaction to the drugs was observed.

Reproductions of roentgenograms in 10 cases illustrate the findings under normal conditions, in tetralogy of Fallot, in Eisenmenger's complex, in transposition of the great vessels, in septal defect, and in venous anomaly. These excellent illustrations should make reference to the original article well worth while.

Nineteen roentgenograms.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Angiocardiography in Coarctation of the Aorta. E. F. Salén and Th. Wiklund. Acta radiol. **30:** 299–315, Nov. 30, 1948.

The authors' angiocardiographic technic is essentially the same as that described by Robb and Steinberg. Skin tests for hypersensitivity to diodrast are made on all patients and a preliminary determination of the arm-to-tongue circulation time is obtained with decholin. The best position for demonstration of the aortic arch is determined fluoroscopically. Then, with the patient upright in front of a mechanical cassette changer, 50 c.c. of 70 per cent diodrast are injected rapidly (within two seconds) into an exposed cubital vein. The first film is obtained after a number of seconds equal to half the calculated circulation time. A total of six exposures are made at intervals of one to two seconds.

A series of 14 cases of coarctation of the aorta examined by this technic is reported. Operation was done in 11 of these. In 6 both preoperative and postoperative angiocardiograms were obtained; in 3 postoperative angiocardiograms only.

The angiocardiographic findings correlated closely with the findings at operation. In most cases angiocardiography gave exact information as to the site of the stenosis in relation to the left subclavian artery. In many, the character and degree of stenosis could be determined by the angiocardiogram. In two patients, postoperative angiocardiography revealed aneurysms arising from the site of anastomosis.

Aortic visualization is apt to be unsatisfactory in patients with associated heart lesions, such as aortic insufficiency or interventricular septal defects.

Six roentgenograms; 10 drawings; 1 photograph.

WYLIE H. MULLEN, JR., M.D.
Cleveland Clinic Foundation

Diagnosis of Pulmonary Stenosis by Angiocardiography. Merl J. Carson, Thomas H. Burford, Wendell G. Scott, and James Goodfriend. J. Pediat. **33:** 525–543, November 1948.

Angiocardiography has proved to be a valuable aid in the differential diagnosis of the cyanotic group of congenital cardiac anomalies. The technic is discussed and the following conditions are well illustrated by roentgenograms in the postero-anterior and right anterior oblique projections: the normal; a nonfunctioning right ventricle and tricuspid stenosis; a persistent truncus arteriosus; and tetralogy of Fallot. The angiocardiographic criteria for diagnosis are:

(A) Non-functioning right ventricle with tricuspid stenosis:
   1. The right ventricle does not fill.
   2. The flow is from the right auricle to the left auricle to the enlarged left ventricle.
   3. Following the above is a simultaneous visualization of the aorta and
   4. Small pulmonary arteries, if pulmonic stenosis is present.

(B) Persistent truncus arteriosus:
   1. A very large right ventricle.
   2. Simultaneous filling of the right and left ventricles due to an interventricular septal defect.
   3. A single arterial outflow tract from both ventricles, which opacifies at the same time that the left ventricle fills, indicating that the truncus overrides the septal defect.
   4. No pulmonary conus; a small artery may be seen arising from the single large truncus.

(C) Tetralogy of Fallot:
   1. Early filling of left ventricle based on interventricular septal defect.
   2. Small caliber of pulmonary arteries. (Differential point from Eisenmenger's complex, where they are normal or unusually large.)
   3. Simultaneous filling of the pulmonary conus, arteries, and aorta indicating the presence of an overriding aorta.
   4. Enlarged right ventricle.

Twenty-five roentgenograms.

HARRY J. PERLBERG, Jr. M.D.
Baltimore (Md.) City Hospitals

Long Survival with a Cardiac Aneurysm. A Codounis. Brit. Heart J. **10:** 244–246, October 1948.

A case of cardiac aneurysm with thirteen years survival is presented. At the time of the report the pa-

tient was still living but the diagnosis was definite, as paradoxical pulsation was constant.

The first evidence of the aneurysm was seen forty-two days after a coronary occlusion but it was interpreted as a pericardial adhesion. Twenty months later the lesion was much larger but fluoroscopy was not done and the diagnosis remained in question until five years after the original attack. Fluoroscopic examination at that time showed "paradoxical diastole."

One other case with a thirteen-year survival has been reported (Clerc and Deschamps: Coeur et vaisseaux, Tome IV. Précis de pathologie médicale. Paris, Masson & Cie, 1931).

Four roentgenograms. ZAC F. ENDRESS, M.D
Pontiac, Mich.

The Heart in the Pneumoconiosis of Coalminers. Arthur J. Thomas. Brit. Heart J. **10:** 282–292, October 1948.

A study of the cardiovascular system was made in a group of 96 cases of coalminer's pneumoconiosis without cardiac involvement due to other causes. The cases were of all degrees of severity from the earliest detectable stage to the final state of advanced disease with right heart failure. The detection of early cardiac involvement is quite a problem because of the extensive lung lesions.

Symptoms of the cardiac phase of the disease are severe dyspnea, gross disability, dependent edema, and upper abdominal discomfort. Physical signs include orthopnea, cyanosis, venous engorgement, enlargement and tenderness of the liver, triple heart rhythm. Eleven patients had actual right heart failure, which proved fatal in 9.

The earliest x-ray evidence of pulmonary heart disease, or cor pulmonale, is enlargment of the outflow tract of the right ventricle, manifested by prominence of the pulmonary conus-artery segment. This is seen in the postero-anterior view as straightening or bulging of the upper left cardiac border and in the right anterior oblique position as an anterior bulging into the retrosternal space. The heart may remain stationary at this stage for a long period of time. If the inflow tract enlarges, the width of the cardiac shadow is increased on the postero-anterior view and the depth on the left anterior oblique view. Right heart failure usually follows quickly once inflow tract enlargement takes place.

Electrocardiographic changes are discussed in detail.

Ten roentgenograms; 5 electrocardiograms; 3 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

Mechanics of Gastro-Intestinal Roentgenology. George H. Stein and Manfred Kraemer. J. M. Soc. New Jersey **45:** 539–545, November 1948.

The purpose of this article is to advise private practitioners as to what type of x-ray equipment to buy, and how to get the most out of their equipment. Hazards and safety factors in fluoroscopy are discussed. The authors' preparation for and technic of upper gastro-intestinal examination, colon examination, and cholecystography are discussed in detail.

EDWARD E. LEVINE, M.D.
Dearborn, Mich.

Pyloric Obstruction More Accurately Demonstrated by Food-Barium Mixture. Vincent W. Archer and George Cooper, Jr. Am. J. Roentgenol. **60:** 593–599, November 1948.

Thirty medical students were studied first with the usual barium-water mixture and, on another occasion, with a breakfast of fruit, cereal, eggs, bacon, toast, milk, and dry barium. In two-thirds of the students an initial half-hour delay in emptying of the stomach following the food-barium mixture was thought to be due to time necessary for reducing the food to a fluid consistency suitable for entrance into the small bowel. From examination of the six-hour residues, it was determined that there was little difference between the two groups except for an occasional individual exhibiting retention of food with no demonstrable disease. Because of these occasional variants, the rate of emptying of the barium-water mixture is not an absolute indication of the stomach's ability to empty food. When the question of surgical intervention arises with clinical evidence of obstruction (usually from ulcer), a barium-food mixture is more helpful than barium-water in evaluating the necessity for surgery. Barium-water may empty in a case where food will not go through.

The suggestion is made that a barium-food study previous to vagotomy would determine whether a gastro-enterostomy should accompany the procedure. If considerable residue is present *before* operation, it will certainly be worse *following* surgery, and a gastro-enterostomy would therefore be necessary.

Six roentgenograms; one table.

R. C. DATZMAN, M.D.
Indiana University

Carcinoma of the Stomach: Its Incidence and Detection. B. R. Kirklin and John R. Hodgson. Am. J. Roentgenol. **60:** 600–602, November 1948.

Approximately 2.4 per cent of patients having roentgen examinations of the stomach at the Mayo Clinic have gastric carcinoma. For all Mayo Clinic patients the incidence of this disease determined roentgenologically is 0.3 per cent. The reported percentage of five-year cures ranges from 2 to 7.

The authors feel that survey roentgen examinations for the detection of carcinoma of the stomach in well persons is entirely impractical. This conclusion is based on the fact that 75 per cent of patients have symptoms for less than one year, some 30 per cent for less than three months, and more than 50 per cent for less than six months before diagnosis, which would necessitate examination at least every three months.

Since 95 per cent of gastric carcinomas develop in persons beyond forty years of age, surveys would have to include all persons more than forty, or 42,000,000 people. It would require 1,917.6 roentgenologists examining a stomach every two minutes for eight hours steadily every day of the year, including Sundays and holidays, year after year continuously, to make a satisfactory survey of this group of people every three months.

J. A. CAMPBELL, M.D.
Indiana University

Gastric Polyps. Leo L. Hardt, Frederick Steigmann, and George Milles. Gastroenterology **11:** 629–639, November 1948.

Analysis of autopsy cases shows that probably about 1.5 per cent of all gastric neoplasms are benign. Such

tumors may cause symptoms for mechanical reasons or as a result of bleeding tendencies.

A study was made of 62 patients with polypoid lesions disclosed gastroscopically, in an effort to compare the diagnostic accuracy of gastroscopy and roentgenography. X-ray examination was negative in 38.2 per cent of the gastroscopically diagnosed lesions and in 28 per cent of surgically proved cases. It was concluded that over 38 per cent of polypoid lesions of the stomach will not be diagnosed by x-ray. Failure to make the diagnosis is more common in the presence of small benign lesions. Gastroscopy, therefore, is almost imperative in patients with gastro-intestinal complaints who give a negative x-ray picture.

The authors could not correlate well the presence or absence of free acid and the appearance of the mucosa with symptoms or final diagnosis.

Six illustrations, including 1 roentgenogram; 1 table.

G. REGNIER, M.D.
University of Arkansas

Polyps of the Stomach and Duodenum. Kristian Overgaard. Acta radiol. **30:** 343–361, Nov. 30, 1948.

Benign polypoid tumors of the stomach or duodenum were identified seventeen times in some 3,600 stomach examinations (approximately 0.5 per cent). The authors report 11 of the cases, and mention briefly the others. Ten of the patients had single polyps and 7 had multiple polyps. In 9 patients polyps occurred only in the stomach, in 5 only in the duodenum, and in 3 in both the stomach and duodenum. In only 1 instance was surgical confirmation obtained, in a patient with an associated carcinoma arising in a chronic gastric ulcer. One patient died of pneumonia. Ten patients showed no appreciable change roentgenographically when re-examined seven to eleven years following the first examination. The remaining 5 patients did not have a follow-up roentgen examination but were alive seven to eleven years after the polyps were first reported.

The author reviews the clinical symptoms and discusses at length the relationship between gastric polyps and gastric carcinoma. He concludes that the presence of a gastric polyp is an indication of a pathologic gastric mucosa in which cancer may develop; however, the polyp may not be an actual precancerous lesion. Except in the presence of obstruction or menacing hemorrhage, the author believes that conservative treatment, with constant observation, is the treatment of choice, particularly in patients of advanced age.

Eleven roentgenograms; 1 table.

JOHN R. HANNAN, M.D.
Cleveland Clinic Foundation

Hyperplasia of Brunner's Glands Simulating Duodenal Polyposis. William H. Erb and Thomas A. Johnson. Gastroenterology **11:** 740–745, November 1948.

The authors report an interesting case of hyperplasia of Brunner's glands simulating duodenal polyposis. The literature is sparse on the subject.

The patient was a 36-year-old white male who was hospitalized because of an apparent progression of multiple polypoid filling defects in the duodenum, observed over a seven-month period. The only subjective complaint was a tendency to loose stools which had been present for about a year. They contained no blood or mucus. Seven months prior to admission a severe secondary anemia was found, which improved with the use of iron and liver preparations. There had been a weight loss of 8 lb. in one year. The polypoid defects were limited to the cap and first part of the duodenum. With the exception of a high gastric acidity, laboratory tests were essentially negative. One week prior to scheduled operation, the patient complained of severe epigastric pain for the first time and vomited once.

After surgical removal of the first part of the duodenum and distal antrum, symptoms persisted, anemia developed, and gastric acidity was high, although somewhat reduced as compared to the preoperative level. One month after operation, roentgen examination indicated a marginal ulcer at the gastroduodenostomy site. Vagotomy was ineffective, and a high subtotal gastric resection was done, with good results.

The authors point out that the high gastric acidity should have been a warning that the defects seen on the x-ray examination were not due to polyps, since achlorhydria has been found in almost all the reported cases of duodenal polyposis in which gastric analysis has been done.

The belief of Florey and Harding (J. Path. & Bact. **37:** 431, 1933; **39:** 255, 1934) that the normal secretion of Brunner's glands protects the duodenal mucosa from damage by the acid gastric juice and that malfunction of these glands might be primarily responsible for duodenal ulcer is considered to be supported by this case.

Three roentgenograms; 1 photograph of the operative specimen.

ERNEST S. KEREKES, M.D.
University of Arkansas

Perforation of the Small Intestine from Non-Penetrating Abdominal Trauma. Boardman Marsh Bosworth. Am. J. Surg. **76:** 472–479, November 1948.

Eleven hitherto unreported cases of perforation of the small intestine from trauma which did not penetrate the abdominal wall are presented, and these and 70 additional cases from the literature are analyzed. In six New York City and suburban hospitals a nonpenetrating traumatic perforation was encountered only once in every 10,000 or 20,000 admissions. On the other hand 2 cases were seen in one of the hospitals within a six-month period.

In most of the collected series of 81 cases the injury was the result of a sudden, severe, and unexpected blow to the abdomen by some blunt object. In 2 instances, however, it was caused by vigorous efforts on the part of a patient to reduce his own hernia.

It was hardly surprising to find that in 82.2 per cent of all cases in which the tear was accurately localized (51 of 62 cases) the lesion occurred at or close to a place where the bowel was firmly fixed to the parietes. In 86.6 per cent of 30 jejunal cases the perforation was within two feet of the ligament of Treitz while, in 74 per cent of 27 ileal cases it was located within three feet of the ileocecal valve. The majority of tears were 1.5 cm. or less in diameter, but there was little correlation between the size of the perforation and the severity of symptoms.

In 39 cases roentgenograms were taken of the erect patient preoperatively. Air beneath the diaphragm was revealed in only 16 of these cases. Only 5 of 9 patients with tears known to be more than 1.5 cm. in diameter showed air beneath the diaphragm, and in only 8 of 23 patients with perforations reported as

1.5 cm. or less in diameter was air seen. No free air in the peritoneal cavity could be demonstrated roentgenologically in one case twelve hours after injury, although the bowel had been torn half-way through. In another case there was no evidence of air beneath the diaphragm in a film taken twenty-four hours following a rupture which involved three-quarters of the bowel's circumference. The author believes roentgen examination is an important part of the diagnostic survey in cases of suspected perforation for when it is positive much valuable time may be saved; he warns, however, against being lulled into a false sense of security when no free air is revealed.

In this group of 81 cases, the total mortality was 34.5 per cent and the operative mortality 29.3 per cent. Delay in operation was the most important single factor in causing death, the mortality rate doubling after the first twelve hours following injury.

Eight tables.

Small Intestinal Motility in Acute Dysentery. George P. Keefer. Am. J. Roentgenol. **60:** 587–592, November 1948.

The author had the opportunity of studying 14 American soldiers in the China-Burma-India Theater who were suffering from acute dysentery. All 14 patients gave a typical clinical picture of bacillary dysentery, but positive stool cultures were obtained in only a single case.

A barium meal was given and a roentgenographic study (but no fluoroscopy) was made of all patients, with films taken at half-hour intervals until the cecum was filled. The term "intestinal motility," as used in describing these cases, refers to the time elapsing between the administration of the meal and the filling of the cecum. All stomachs and duodenums were normal. One case showed increased motility in the jejunum but the over all transit time was normal. Four patients showed normal small intestinal motility. One patient had a rapid motility, with the barium reaching the cecum in half an hour. Nine patients had delayed motility (three and a half to seven and a half hours), the chief delay being in the pelvic loops of the ileum. The colon was examined only on twenty-four-hour films and showed no abnormalities. It was felt that the tone of the intestine was increased.

Five patients had a repeat study after seven to ten days and all were considered normal except for one patient who showed some ileal stasis. No explanation for the hypomotility can be offered, but fluid imbalance, deficiency states, and organic changes in the terminal ileum enter into consideration.

Eight roentgenograms. J. LORMAN, M.D.
Indiana University

Roentgenologic Differential Diagnosis of Tumors of the Small and Large Intestine. E. Ruckensteiner. Radiol. clin. **17:** 313–333, November 1948. (In German)

Tumors of the colon are easier to diagnose than those of the small intestine. Anatomical and technical reasons account for the relatively poor diagnosis of lesions of the small bowel.

Ruckensteiner cites a few cases in order to illustrate the difficulties. One patient, a 69-year old male, had all the clinical and radiological signs of a terminal ileitis, and surgery revealed multiple carcinoids of the distal portion of the ileum. In another case, a 50-year old male showed a narrowing of the jejunum about 10 cm. distal to the duodenojejunal flexure with a small cavity formation. The preoperative diagnosis was possible sarcoma, and surgery revealed a large carcinoma in this region. The third case was that of a 43-year old soldier whose tumor was diagnosed as a carcinoma of the small bowel but proved on surgery to be a lymphosarcoma.

In tumors of the colon we are more certain as regards preoperative diagnosis, but even here we can be misled. A 33-year old woman had a tumor in the left upper quadrant of the abdomen, with narrowing of the lumen of the transverse colon. The preoperative diagnosis was carcinoma of the colon, but surgery revealed an inflammatory mass with abscess formation due to a fish bone. In two other cases the preoperative diagnosis of an inflammatory lesion of the colon was confirmed by surgery.

The author also gives a general discussion of the benign, malignant, and inflammatory lesions of the small and large bowel, and emphasizes that the roentgenologist should be careful in making a pathological diagnosis. A differential diagnosis as between benign and malignant tumors of the small intestine is extremely difficult, because of frequency of accompanying inflammatory processes. Lesions of the colon can be diagnosed almost as accurately as can those of the stomach. On the other hand, in our present state of knowledge, an exact diagnosis of localized diseases of the small intestine must necessarily be made with reservations. EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Duodenocolic Fistula Complicating Carcinoma Coli. E. P. Hall Drake and J. F. Goodwin. Brit. J. Surg. **36:** 204–207, October 1948.

Two cases of duodenocolic fistula are reported occurring as a complication of cancer of the colon. The first patient was treated for diarrhea for several weeks before the recognition of a mass led to examination by barium enema. A barium meal had been given earlier with no findings. The enema immediately showed the fistulous connection between the colon and duodenum, with a carcinoma at the hepatic flexure. Surgical removal was done but six months later a recurrent mass was present in the abdomen.

The second patient was practically moribund on admission, the fistula having caused a severe diarrhea, with loss of weight and edema from protein deficiency. A barium enema study showed carcinoma at the hepatic flexure and reflux into the duodenum and stomach. Autopsy confirmed the findings.

Three roentgenograms; 1 photograph; 1 drawing.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Roentgen Diagnosis of Volvulus of the Cecum. John P. McGraw, Arnold J. Kremen, and Leo G. Rigler. Surgery **24:** 793–804, November 1948.

Volvulus of the cecum occurs only in association with abnormal mobility. Twisting of 180° is necessary to produce obstruction; any further twisting produces strangulation. About 1 per cent of intestinal obstruction is caused by volvulus of the cecum (or, to be more accurate, volvulus of the right half of the colon usually plus a variable amount of ileum). The authors be-

lieve that the criteria for diagnosis are present in simple films of the abdomen and that the barium enema is not an essential diagnostic procedure, although it may furnish helpful confirmatory evidence. The cecum is dilated and in an abnormal position. Often dilated loops of small bowel can be seen lying to the right of the cecum, and at times the ileocecal valve can be demonstrated on the right of the cecum. Spiral mucosal folds at the cone-shaped site of obstruction are pathognomonic. The twisted mucosal folds may occasionally be seen in the simple film of the abdomen by contrast with the surrounding mucosa.

A differential diagnosis must be made from volvulus of the sigmoid, adynamic ileus, and organic obstruction of the transverse or left colon. Utilization of the barium enema is advisable where a serious difficulty in differentiation occurs. When it is given with care, there is little or no danger and the exact site of obstruction or torsion of the colon may well be demonstrated, making the diagnosis perfectly definite.

Four cases are presented, 3 of which have been confirmed by surgery. The article with case reports and illustrations should be seen in the original. After reading it one should be able to make the diagnosis, provided, of course, that he thinks of it.

Twelve roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Calcified Omental Fat Deposits: Their Roentgenologic Significance. John F. Holt and Robert S. MacIntyre. Am. J. Roentgenol. **60:** 612–616, November 1948.

Three cases of calcified omental fat deposits seen on abdominal roentgenograms are presented. These occurred as single or multiple mobile nodules which changed position on subsequent films. The findings were incidental, but were confusing from the standpoint of differential diagnosis of other intra-abdominal concretions. Two of the cases were proved histologically.

A fourth case was similar to the others roentgenographically, but laparotomy revealed a calcified detached epiploic appendage similar to the two cases of loose intraperitoneal calcified fat bodies described by Barden (Radiology **33:** 768, 1939).

These calcifications have no typical roentgen appearance. They are of no clinical importance except in being mistaken for other significant forms of intra-abdominal calcifications. Their round or oval shapes, with greater concentration of calcium in the periphery, and a marked degree of inherent mobility help to distinguish them.

Eight roentgenograms. J. A. CAMPBELL, M.D.
Indiana University

Strangulating Diaphragmatic Hernia of the Liver. Report of a Case with Surgical Cure. Samuel A. Wolfson and Alfred Goldman. Surgery **24:** 846–852, November 1948.

Herniation of the liver through the right hemidiaphragm is a recognized condition but strangulation of such a hernia has not previously been reported. In the case recorded here, clinical symptoms suggested a diaphragmatic hernia but roentgenograms led to a preoperative diagnosis of mediastinal tumor. At operation the mass that had been interpreted as a tumor was found to be normal liver, bulging through a narrow tendinous ring in the posterior medial leaf of the diaphragm into the pleural cavity. At the point of herniation the organ was constricted about 50 per cent. The diaphragmatic constriction was cut and the liver retracted. The weakened area of the diaphragm was plicated and a phrenic crush done. Postoperative films showed a normal but elevated right diaphragm.

Three roentgenograms; 1 drawing.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Subphrenic Abscess. A Critical Survey of Twelve Cases. R. S. Hunt. Brit. J. Surg. **36:** 185–197, October 1948.

There are seven so-called spaces between the diaphragm and the transverse colon where subphrenic abscess may occur. Three of these are on the right, one below the liver and two above it separated by the triangular ligament; three are on the left, one superior and two inferior separated from each other by the lesser omentum, the stomach, and the anterior layer of the greater omentum (the left posterior space is more commonly called the lesser peritoneal sac). The seventh space, which is extraperitoneal, is the "bare area" of the liver. Infection seldom corresponds to these anatomical boundaries, however, sometimes filling only part of a space and frequently involving more than a single space.

Twelve cases of subphrenic abscess are reported in detail, all seen in a period of sixteen months. Most of these developed in spite of sulfa drugs and penicillin and none cleared without surgery. Three were secondary to perforated ulcers, 1 to a traumatic perforation; 2 followed appendectomies; 1 followed a perinephritic abscess, 2 had unknown causes, and 3 were thought to be secondary to amebic abscesses of the liver.

Seven of the cases are illustrated with roentgenograms. All showed a high immobile diaphragm with varying reaction at the base of the lung. Four showed a fluid level in the abscess cavity. When a fluid level is demonstrated, the size, shape, and most dependent part of the abscess cavity may be visualized and indicate the best surgical approach. It is important that drainage be established at the lowest point, or reoperation will be necessary. Pneumoperitoneum was used in one case to make the diagnosis. Positive findings, of course, consist of absence of the injected air beneath the diaphragm on the suspected side and the presence of air on the opposite side.

Subphrenic abscess is not a difficult diagnosis to make provided it is kept in mind. Fluoroscopy of the chest should be done, and upright, well-penetrated films of the upper abdomen obtained, with lateral views for localization if disease is found.

Fifteen roentgenograms; 32 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE MUSCULOSKELETAL SYSTEM

The Development of X-Ray Diagnosis in Orthopedic Surgery. Walter G. Stuck. South. M. J. **41:** 965–971, November 1948.

This paper, the address of the Chairman of the Section on Orthopedic and Traumatic Surgery of the Southern Medical Association, at its meeting in October 1948, traces the history of x-ray diagnosis in orthopedic surgery and calls attention to the role played

by contemporary surgeons in the evolution of radiology. The author writes: "The sudden evolution in a few years of an entirely new conception of diagnosis and the development of methods which completely transformed orthopedic surgery depended upon the work of great discoverers in the field of x-ray and orthopedic surgery. It is proper to recall that each group played an essential part in this development and that their interdependence became apparent even at that early period."

Progress in Orthopedic Surgery for 1946. A Review Prepared by an Editorial Board of the American Academy of Orthopaedic Surgeons. I. Chronic Arthritis. John G. Kuhns. Arch. Surg. **57:** 729–742, November 1948. **II. Conditions Involving the Knee Joint.** Ralph K. Ghormley, *et al.* Ibid. pp. 743–751. **III. Conditions Involving the Foot and Ankle.** Emil D. W. Hauser. Ibid. pp. 752–762.

Attention is called to the three papers referred to in the title, as useful reviews of the literature. The radiologic aspects have been covered in original papers and abstracts appearing in RADIOLOGY.

Dyschondroplasia; Metaphyseal Dysostosis. H. A. Thomas Fairbank. J. Bone & Joint Surg. **30-B:** 689–708, November 1948.

Ollier's disease or multiple enchondromata is a rare condition characterized by masses of cartilage in the metaphyses and diaphyses of bones. It results from a disturbance in the epiphyseal line in which nests of cartilage become misplaced and are not calcified and ossified in the normal manner. The cause is unknown. The diagnosis is usually made in childhood.

The distribution may be localized, or many bones may be involved. The long bones of the hands and feet are a frequent site. Clinically the chief finding is shortening of the affected limb.

Roentgenograms of bones affected by this disease reveal masses of cartilage of varying shape appearing as areas of radiolucency in the bone. The density of bone between the cartilaginous masses may be increased. There may be curvature of affected bones. Occasionally a small islet of cartilage may be seen lying in the cortex of the bone. In children from five years of age upward there may be mottling and streaking of the epiphyses. In the digits, expansion and loss of continuity of the cortex are common. In older children, dense areas may be scattered throughout an affected metaphysis and even in the adjacent epiphysis, suggestive of ossification and healing.

There seems to be little tendency except in the hand for the masses of misplaced cartilage to proliferate. Cartilage proliferation after growth has ceased is unusual. Chondrosarcoma as a complication is still more rare.

Diagnosis is not difficult if sufficient bones are examined roentgenographically.

Dyschondroplasia associated with cavernous hemangiomata and phleboliths in the soft tissues constitutes Maffucci's syndrome.

Eight cases of dyschondroplasia are presented, with 20 roentgenograms.

A case of metaphyseal dysostosis is also presented, with 6 illustrations. In this rare condition the metaphyses of long bones consist for the most part of unossified cartilage.

JOHN R. HODGSON, M.D.
The Mayo Clinic

"Rheumatoid Disease" with Joint and Pulmonary Manifestations. Phillip Ellman and R. E. Ball. Brit. M. J. **2:** 816–820, Nov. 6, 1948.

Rheumatoid arthritis is considered by the authors as a systemic disease with widespread pathological changes in various organs and tissues and local manifestations in the involved joints. The bones exhibit atrophy and even widespread cystic changes; peripheral nerves may be involved with resultant neuritic pains, paresthesias and trophic changes; biopsy studies of muscle show alterations in the form of perivascular lymphocytic infiltration and macrophages in the perimysium and endomysium as seen in periarteritis nodosum and disseminated lupus; cardiac changes almost identical with those of rheumatic fever may be found, and there may be lesions in the spleen, liver, lymph nodes, pleura, and even in the eye. In one case there was reason to believe a kidney lesion was part of the rheumatoid process.

The purpose of the article is to report three cases in which a pulmonary lesion appeared as an integral part of the "rheumatoid state." The patients described ranged in age from 47 to 55 years. All had fairly typical histories of gradually progressing joint involvement of the rheumatoid type. None gave a history or showed evidence of true rheumatic fever. All eventually showed a peculiar reticulation throughout both lung fields, with increase in the hilar and linear shadows and evidence of a chronic bronchopulmonary lesion. Two of the patients came to autopsy.

The pulmonary changes were those of an interstitial pneumonitis with terminal bronchopneumonia and, in one case, some small abscesses. The alveoli contained considerable albuminous exudate. There was a well marked fibrosis between lung alveoli, and infiltration with mononuclears and some polymorphonuclears was prominent. Some giant cells could be seen. A few of the blood vessels showed fibrinoid degeneration with endothelial proliferation in the muscle coat. The vessel walls were infiltrated by mononuclear inflammatory cells. There was no evidence of tuberculosis or sarcoidosis.

In all three cases, the clinical course was similar, the joint lesions preceding the pulmonary lesions. The latter are very similar to the stage-three changes of "rheumatoid pneumonia." Similar pathological pulmonary changes have been noted in disseminated lupus erythematosus and an allied group of so-called granulomata.

Four illustrations, including 2 roentgenograms.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Primary Chronic Polyarthritis on the Basis of a Peripheral Vascular Disturbance (Polyarthrosis). A. Leb. Radiol. Austriaca **1:** 43–52, 1948. (In German)

The roentgen findings in a polyarthrosis of the hands show an absence of inflammatory and evidence of degenerative changes. Bone atrophy is not present as in rheumatoid arthritis. The author used arteriography with thorotrast in 40 patients with degenerative arthritic changes of the hands and found non-filling of the arteries of the middle and distal phalanges to some extent in all of them. He believes that a partial ischemia leads to nutritional disturbances and degenerative changes in the joint cartilage. He found that these arterial changes are present many years before clinical or roentgenological joint changes. When

the first radiologic signs of a narrowed joint space (usually in the middle and distal joints of the fourth and fifth fingers) are present, the narrowed arterial bed can already be shown on arteriograms and therefore must precede the degenerative changes of the cartilage.

Five roentgenograms.

H. W. HEFKE, M.D.
Milwaukee, Wis.

Early Diagnosis of Acute Septic Osteomyelitis, Periostitis and Arthritis and Its Importance in the Treatment. Sigvard Jorup and Sven Roland Kjellberg. Acta radiol. **30:** 316–325, Nov. 30, 1948.

The authors emphasize the importance of roentgenograms in making an early diagnosis of acute septic osteomyelitis, in order that antibiotic therapy and chemotherapy may be instituted prior to the onset of bone destruction. Often the diagnosis can be made roentgenographically on the second or third day after onset of symptoms. If low kilovoltage, increased focal-skin distance, decreased object-film distance, and no screens are used, roentgen changes are readily visible in the soft tissues. These early roentgen findings consist of swelling of surrounding muscles and blurring of intermuscular septa; swelling of the subcutis; and, if a joint is involved, distention of the joint capsule. Edema and vascular congestion are responsible for these changes. Five cases are presented demonstrating these soft-tissue signs and illustrating the value of early diagnosis from a therapeutic standpoint.

Thirteen roentgenograms.

ROBERT M. GEIST, M.D.
Cleveland Clinic Foundation

Concerning the Pathogenesis of Osteitis Deformans (Paget). Konrad Weiss. Radiol. Austriaca **1:** 3–25, 1948. (In German)

The roentgen appearance of a typical Paget's disease is well known. The early changes, however, and their slow development into the typical pathologic and roentgenologic phase need more consideration.

The author has followed several cases of osteoporosis circumscripta cranii through many years and found that a circumscribed osteoporotic area in the skull progresses about one centimeter during a year. It took at least eight years from the first appearance of the osteoporotic area to the typical appearance of Paget's disease. The osteoporotic stage is rarely found in the long bones or the vertebral bodies; re-ossification apparently takes place in a much shorter time, about one year. The pathological-anatomical studies of Erdheim and his group give considerable information about the course and nature of the disease.

After re-ossification and re-calcification, the bone affected by Paget's disease may again show an osteoporotic involution due to senile changes. Pathological fractures in bones with Paget's disease are not uncommon; they normally heal well. Malignant changes are occasionally seen.

Twenty-one roentgenograms.

H. W. HEFKE, M.D.
Milwaukee, Wis.

Schüller-Christian's Disease. Two Cases in Adults. Åke H. Mellbye. Acta radiol. **30:** 279–290, Nov. 30, 1948.

The author presents the fourth and fifth cases of Schüller-Christian's disease to be recorded in the Norwegian literature, both in adults. The clinical course in these older patients is believed to be more benign than in children, in whom the disease is more frequently seen.

One of the author's patients, a 47-year-old male, had first noticed a tumor behind his right ear twenty years previously. Skull defects in this region were demonstrated radiologically. The sella turcica was enlarged and there were areas of bone destruction in the spine and the right fibula. Biopsy was equivocal but was reported as compatible with Hand-Schüller-Christian's disease, though suggestive also of Gaucher's disease. The tissue gave no lipoid reactions. The skull defects received 900 r (no technical details given) without evidence of any response at the end of three months.

The second case was that of a 21-year-old man who presented a soft-tissue tumor below the right iliac crest with no local bone involvement. The histologic picture of the resected specimen was regarded as compatible with Hand-Schüller-Christian's disease. Map-like defects were demonstrable in the skull.

The historical background and pathology of Schüller-Christian's disease are discussed. The author feels that Letterer-Siwe's disease, Schüller-Christian's disease, eosinophilic granuloma, and infectious reticuloendotheliosis are variants of the same disease process.

Five roentgenograms; 2 photographs; 2 photomicrographs.

A. A. RAYLE, JR., M.D.
Cleveland Clinic Foundation

The Etiological Relations of Precocious Puberty, Fibrous Dysplasia of the Bones and Pigmentation of the Skin (Albright's Syndrome). Abraham O. Wilensky. Arch. Pediat. **65:** 608–616, November 1948.

The author reports a case of Albright's syndrome in a young girl who, in addition to the usual findings, had a simple cyst in the right breast. The salient features of Albright's syndrome include: precocious general development with early appearance of the menstrual function in the female; fibrocystic bone lesions; a brown patchy pigmentation of the skin; a tendency towards unilaterality of the lesions.

The present prevailing opinion is that the condition is essentially a neurological one, based on a hypothalamic disturbance and acting through the hypophysis and the other ductless glands, and that this is sometimes related to a neoplastic pineal and/or adrenal growth. Inasmuch as no other explanation is plausible, it must ultimately be predicated upon a chromosomal or genetic basis.

WILLIAM H. SMITH, M.D.
Louisville, Kentucky

Reticulum Cell Sarcoma of Bone. V. R. Khanolkar. Arch. Path. **46:** 467–476, November 1948.

Five cases of primary reticulum-cell sarcoma of bone observed during the last six years in Bombay, India, are reported. The necessity for early recognition of the disease is emphasized in view of the favorable response to therapy in many cases. In the author's opinion, the roentgen findings are definite but not characteristic, consisting of a mottled or diffuse osteolytic process with little evidence of new bone formation at the periphery of the lesion or under the periosteum. Bone trabeculae appear to melt away as they are involved in the sarcomatous infiltration. Roentgen therapy in 3 of the 5 cases seemed to effect not only a

regression of the tumor but also a condensation of osseous trabeculae and a regeneration of bony tissue in completely destroyed areas.

Seven illustrations, including one roentgenogram.

Spinal Extradural Cysts. J. G. du Toit and M. H. Fainsinger. J. Bone & Joint Surg. **30-B:** 613–618, November 1948.

The authors report what they believe to be the twenty-fifth case of spinal extradural cyst to be recorded in the literature. There appear to be two distinct types of extradural cyst. The first is seen in adolescents and is associated with progressive spastic paraplegia, dorsal kyphosis of the Scheuermann type, and signs of an expanding tumor in the neural canal of the dorsal region. The second type occurs in adults in the lumbodorsal spine. There is no dorsal kyphosis, although the radiographic examination indicates an expanding intraspinal lesion of the upper lumbar region.

The authors' patient was a 42-year old female with a progressive fifteen-year history of weakness of the left leg, pain in the lumbar region, and cramps in the left foot.

Roentgenograms showed abnormal interpeduncular measurements at the tenth and eleventh dorsal and the first and second lumbar vertebrae. There was also hollowing of the posterior surfaces of the bodies of these vertebrae, enlargement of the intervertebral foramina, and flattening and atrophy of the medial aspects of the pedicles.

Myelographic findings indicated the presence of a large mass in the spinal canal, deforming the theca at the level of the first lumbar vertebra and obstructing it at the level of the second and third lumbar vertebrae.

Laminectomy from the tenth dorsal to the third lumbar vertebra revealed three large cysts containing clear colorless fluid lying posterior to the dura, extending laterally and actually protruding through the intervertebral foramina.

The origin of these cysts has not been finally established. They may be due to a congenital diverticulum of dura mater or a herniation of arachnoid through a defect in the dura. The authors felt that at least one of the cysts communicated with the subarachnoid space. Lumbar extradural cysts become manifest at a later age than dorsal cysts.

Four roentgenograms; 2 photomicrographs.

JOHN R. HODGSON, M.D.
The Mayo Clinic

The Lumbosacral Articulation. A Roentgenologic and Clinical Study with Special Reference to Narrow Disc and Lower Lumbar Displacement. Ernest A. Brav, Howard A. Molter, and Wendell J. Newcomb. Surg., Gynec. & Obst. **87:** 549–560, November 1948.

In a series of 500 roentgenograms of the lumbosacral region, 181 showed disk narrowing or displacement. There was narrowing of the fifth lumbar disk at the posterior margin in 132 cases (26.4 per cent of the series of 500); the disk was displaced posteriorly in 51 cases, or 10.2 per cent, and anteriorly in 25, or 5 per cent. The fourth lumbar disk was narrowed posteriorly in 18 cases, or 3.6 per cent (in 13 cases in association with a narrow fifth lumbar disk); it was displaced posteriorly in 13 cases and anteriorly in 2.

There was little difference in the symptoms and clinical signs between the group of 181 with demonstrable roentgen changes and in the remainder of the 500 cases, which the authors have used as a control series. The clinical diagnosis was identical in the groups. There was, however, a higher incidence of lumbosacral arthritis in those cases showing disk narrowing or displacement.

Four hundred and five patients complained of back pain, and in 145 of these there was associated leg pain; in the remaining 95 neither of these complaints was recorded. The incidence of narrowing of the fifth lumbar disk was not significantly different in these three groups, but there was a lower incidence of displacement in the symptom-free group. This is in accord with Ferguson's (Radiology **22:** 548, 1934) denial of any relationship between narrow lumbosacral disk and the incidence of sciatic pain. Barr and Mixter (J. Bone & Joint Surg. **23:** 444, 1941), quoted by the authors, believe that a narrow lumbosacral interspace occurs about as frequently as other congenital abnormalities, and should be considered as an incidental finding unless there is an associated sclerosis or spur formation. Willis (J. Bone & Joint Surg. **17:** 347, 1935; **23:** 410, 1941) noted narrow disk in only 7.6 per cent of a series of patients with back and leg pain.

Because it has been suggested that a difference in the anteroposterior diameter of the fifth lumbar and first sacral segments might produce the appearance of displacement, the authors made a special study of their films with this in mind. They conclude that "posterior displacement of the fifth lumbar vertebra is apparently a definite entity and is not due entirely to difference in anteroposterior diameters of the fifth lumbar vertebra and the sacrum, although in about 20 per cent this is apparently the reason for the appearance on the roentgenogram. It is possible that in cases of posterior displacement, there is secondary atrophy of the anterior edge of the sacrum which decreases the anteroposterior diameter of the first sacral segment."

Anterior displacement of the fifth lumbar vertebra, on the other hand, is usually associated with a defect in the interarticular portion of this vertebra. In addition, there is, in a large percentage of cases, anterior lipping of the sacrum which increases the anteroposterior diameter of the first sacral segment.

The incidence of narrowing of the disk was not much greater in cases of herniated nucleus pulposus or posterior disk protrusion than in the remainder of the series. A narrow disk on the roentgenogram is therefore not considered by the authors as clinical evidence of posterior disk protrusion. A narrowed disk and displacement of lumbar vertebrae are significant, however, in that an additional strain is placed on an already mechanically vulnerable lumbosacral joint.

The important conclusion drawn by the authors is that in most instances, narrow fifth lumbar disk and lower lumbar displacements are in themselves not the cause of low back and sciatic pain. The presence or absence of pain depends upon the integrity of the surrounding muscular and ligamentous structures. When they are unable to compensate for the abnormal mechanical strain, pain may occur because of tension on muscle and ligamentous attachments, degenerative arthritic changes in the articular facets or actual pressure on the spinal nerves at some point in the region of the deranged lumbosacral articulation.

Five roentgenograms; 3 drawings; 2 tables.

DAVID S. MALEN, M.D.
University of Pennsylvania

A Correlation of Neurologic, Orthopedic, and Roentgenographic Findings in Displaced Intervertebral Discs. Francis C. Grant, George Austin, Zachary Friedenberg, and Alton Hansen. Surg., Gynec. & Obst. **87:** 561–568, November 1948.

Ninety-five cases of displaced lumbar intervertebral disks were carefully analyzed as to subjective and objective results of surgery. Careful neurologic and orthopedic examinations were performed, as well as roentgenographic studies, and the patients were interrogated as to their personal opinions of the results of operation.

Eighty-seven per cent of the group were fully satisfied with the operation, although only 60 per cent were regarded as completely cured. The end-results were more gratifying in proportion to the degree of displacement of the nucleus pulposus but it is clearly pointed out that lost or diminished Achilles reflexes do not often return, and recovery from paralyses is also variable.

No relationship was shown between abnormal narrowing of an intervertebral space as demonstrated roentgenographically and the clinical result. The presence of significant quantities of residual opaque oil in the dural sac also seemed unrelated to the clinical result. In diagnosis air myelography was helpful but not as accurate as desired. Pantopaque myelography is preferred, and the authors advise that it should be routinely employed.

Factors shown to have no relation to this type of injury were age, trauma, and occupation. Also the type of operative procedure appeared to have no effect on the eventual outcome.

In the words of the authors, "The fundamental principle for good results is the careful selection of patients with exclusion of those cases that fail to measure up to an exacting history and physical examination supported by myelography."

Eight roentgenograms; 2 charts.

PAUL W. EYLER, M.D.
Unniversity of Pennsylvania

Report on 116 Cases of Intervertebral Discs. Charles Rombold, H. O. Anderson, and H. O. Marsh. J. Kansas State M. Soc. **49:** 453–455, November 1948.

The authors review their results in the surgery of 116 cases of retropulsed intervertebral disks diagnosed and operated upon between June 1944 and October 1946. Their technic during this period slowly evolved from a simple removal of the herniated disk to removal plus spontaneous spinal fusion. The diagnostic procedure used during this time also changed, since myelography was not used after the first 22 cases.

From these cases, with follow-up studies, the following conclusions were drawn:

(1) Radiopaque studies are not necessary for the diagnosis of a retropulsed intervertebral disk. An accurate diagnosis can be made from a careful history, physical examination, and routine x-ray films. The radiopaque material has a detrimental effect on some patients, producing a peripheral neuritis.

(2) Loss of the Achilles reflex with or without sensory changes usually places the lesion between the fifth lumbar and first sacral segments. Purely sensory disturbances without reflex changes usually place the lesion between the fourth and fifth lumbar segments.

(3) Narrowing of the intervertebral space on radiographic examination is considered to be of some significance in the diagnosis of a retropulsed intervertebral disk.

(4) Removal of the herniated disk with a simultaneous spinal fusion will produce an appreciably higher percentage of good results than the simple removal of the herniated material. Fusion does not add to the surgical risk or significantly prolong the hospital stay.

Six tables.

D. R. BRYANT, M.D.
Henry Ford Hospital

Twenty-Five Easy Ways of Getting into Trouble in the Care of Fractures. Fraser B. Gurd. Am. J. Surg. **76:** 506–514, November 1948.

Under the headings "errors made before treatment," "errors during actual treatment," and "errors during the healing period," the author discusses briefly the various ways the surgeon can get into trouble in dealing with fractures. Four of these are of interest to the radiologist: (1) failure to obtain adequate preoperative roentgenograms; (2) failure to identify films; (3) failure to interpret films correctly, especially those of the carpal region; and (4) failure to check maintenance of reduction by roentgenograms.

Seven roentgenograms.

Unrecognized Fractures in High School Athletes. W. K. Foster and John C. Wells. Minnesota Med. **31:** 1206–1209, November 1948.

A series of cases is presented in which fractures were discovered after athletic injuries thought to be relatively minor. The conclusion was reached that all such injuries should be x-rayed to prevent permanent damage. Practically all of the boys concealed or belittled their injuries to keep from being considered a "sissy," with the result that many of the fractures were old when first seen. This relative lack of subjective clinical findings should be kept in mind when reading films on athletic injuries.

Eight roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Contribution to the Radiologic and Clinical Study of Fractures of the Radial Sesamoid of the Thumb. G. Voluter and A. Calame. J. de radiol. et d'électrol. **29:** 569–572, 1948. (In French)

Traumatic lesions of the sesamoid bones of the thumb are extremely rare due to the fact that they are quite well protected against violent trauma. The homonymous sesamoids under the great toe are less favorably situated and are more frequently involved in both fracture and degenerative disease. On the thumb, the cubital sesamoid is better protected than the radial sesamoid.

A case is presented in which the radial sesamoid of the right thumb of a 26-year old male was fractured in an automobile accident. The patient had struck the panel of the car with the right hand, the violence being centered at the base of the thumb. The periosteum was not clearly broken, but condensation and effacement of the polyhedric trabeculation were demonstrable. In the differential diagnosis one must take into consideration the variation in form of intact sesamoids and the fact that bi-, tri- and polypartition of the sesamoid bones do occur.

Traumatisms of the radial sesamoid bone may be

direct (contusion and crushing) or indirect (effect of brusque traction of the tendons inserting on the sesamoid). Fractures heal spontaneously and without complications.

Five illustrations, including 2 roentgenograms.

CHARLES NICE, M.D.
University of Minnesota

Fatigue Fracture of the Ulna. Ian D. Kitchin. J. Bone & Joint Surg. **30-B:** 622–623, November 1948.

A fatigue fracture of the ulna is reported. The symptoms began while the patient was shoveling farmyard manure into a wagon from a tightly packed heap, with a stable fork. Examination revealed a fusiform swelling of the middle third of the forearm, with heat, tenderness, and edema. The roentgenogram demonstrated a fracture of the mid-shaft with "considerable callus formation in the region of the fracture."

In deciding whether or not this was a fatigue fracture, due weight must be given to the history. Searching inquiry revealed no history of a fall, blow, or other injury. The work was heavy and the left forearm supported both the downward thrust of the right hand and the pull of the resisting load. The resulting strain was very considerable.

Three roentgenograms. JOHN R. HODGSON, M.D.
The Mayo Clinic

New Knowledge of Intertrochanteric Fractures: Their Roentgen Appearance and Pathogenesis. Herbert Moser. Schweiz. med. Wchnschr. **78:** 1088–1092, Nov. 6, 1948. (In German)

The author believes that the usual anteroposterior and lateral views of the hip are insufficient in intertrochanteric fractures. The external rotation of the shaft is poorly demonstrated, and the line of the x-ray beam fails to traverse the fracture plane to visualize adequately the extent, direction, and amount of displacement. To overcome this difficulty, he adds a 40°–45° oblique view with the patient rolled toward the injured side, which gives a much more complete idea of the fracture. With the aid of this view, he distinguishes, in addition to the "typical" form of this fracture, an intertrochanteric double fracture, a combined rotary and jog type, an isolated fracture of the greater trochanter proper, and finally isolated fracture of the lesser trochanter.

Nine roentgenograms; 3 photographs.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Posterior Dislocation of the Shoulder Joint. C. K. Warrick. J. Bone & Joint Surg. **30-B:** 651–655, November 1948.

Dislocation of the shoulder joint with backward displacement of the humeral head is an unusual injury. This condition has been overlooked in the past, possibly partly because of its rarity and partly because of a lack of adequate roentgenograms.

Stereoscopic views are satisfactory in demonstrating the dislocation, but these films cannot be viewed by the surgeon until they are dry. In emergency work there are three projections which may be used: (1) transthoracic lateral projections; (2) vertical projections with the tube in the axilla, arm abducted, and film above, or with a curved cassette in the axilla and tube above; (3) profile projections in the postero-oblique axis with the patient erect.

The author feels that the vertical view with a curved cassette in the axilla is probably best, but if this is impossible, the postero-oblique or profile view of the scapula gives a satisfactory picture of the dislocation.

Three cases are reported, with 5 illustrative roentgenograms. JOHN R. HODGSON, M.D.
The Mayo Clinic

Fifteen Observations of Aseptic Osteonecrosis of the Humeral Supratrochlear Septum. André Rescanières. J. de radiol. et d'électrol. **29:** 626–627, 1948. (In French)

The osseous lamina which separates the coronoid fossa from the olecranon fossa is rather frequently the site of aseptic necrosis; sequestra form and separated fragments may fall into the articular cavity of the elbow. Three successive phases of the process, each presenting a characteristic radiologic picture, are recognized: the intraseptal phase, in which necrosis occurs in the anterior or posterior portion of the septum; the phase of separation of the sequestrum; the phase of the articular foreign body.

Clinical signs include limitation of movement and rheumatoid-like pain. Exacerbations and remissions occur, lasting for weeks. The right elbow is usually affected.

The septal region is above the epiphysis and therefore is not an area in which epiphyseal necrosis occurs. Since it is separated from cartilaginous areas, osteochondritis does not enter into consideration. The fibrocartilaginous tissue present in the sequestrum is rather a result of cartilaginous metaplasia of osseous tissue. The process would thus appear to be analogous to osteonecrosis dissecans.

Treatment consists in surgical extraction of the sequestrum or of the free body in the joint.

The author's observations are based on 15 cases, but no details of these are included.

CHARLES NICE, M.D.
University of Minnesota

Developmental Coxa Vara. A. B. Le Mesurier. J. Bone & Joint Surg. **30-B:** 595–605, November 1948.

Developmental coxa vara is characterized clinically by a limp or waddle, usually painless, appearing at the age of three or four years. The condition is rare and there seems to be some familial tendency. In the author's series of 16 patients, 4 were related—a brother and sister and two second cousins.

The development of the limp as observed in this series was gradual. More commonly it was progressive over a period of six or seven years. In the more severe cases, limitation of abduction, extension, and rotation movement in both directions was present, although there was no marked external rotation deformity such as is seen in slipped epiphysis.

Roentgenographically varying degrees of coxa vara are seen but the outstanding feature is the gap in the neck of the femur just distal to the epiphyseal line. Even in the early stages this is obvious. In most of the author's cases, the course of this gap was parallel to the epiphyseal line, but toward one end, usually the lower, it branched away and sometimes divided, leaving a triangular portion of bone more or less isolated. The gap was not broad and it did not follow a straight line with clear-cut edges; the margins were usually uneven. Just distal to the gap the bone was abnormal

in appearance, irregular areas of greater density alternating with areas of lesser density, giving rise to an appearance described as fragmentation. The femoral head was often less dense than normal. The epiphyseal line was usually narrow and sometimes could be seen only with difficulty. The gap in the bone is not the epiphyseal line, and developmental coxa vara should not be confused with slipped epiphysis, which occurs at a different level and at a later age.

The author feels that the probable explanation for this condition lies in faulty development of the neck of the femur with imperfect formation in cartilage and with delayed and incomplete ossification. The varus deformity is due in part to bending of the unossified cartilage, but the shortening of the neck is due largely to the lack of growth at the epiphyseal line, which is never normal in appearance. In no case in this series was tissue removed for examination.

Treatment by means of traction alone was found to be unsatisfactory. In the late cases abduction osteotomy between or below the trochanters produced satisfactory results. In the early cases good results were obtained by bone graft.

Eighteen roentgenograms.

JOHN R. HODGSON, M.D.
The Mayo Clinic

Osteitis Pubis. Milton L. Rosenberg, and Samuel A. Vest. J. Urol. **60:** 767–775, November 1948.

The authors present 4 cases of osteitis pubis, bringing the total number of recorded cases to 52. A brief review of the literature is presented.

Osteitis pubis is a clinical syndrome characterized by sudden onset of severe pain and tenderness over the symphysis pubis from two weeks to two months after operations in the bladder region. Two of the authors' cases followed retropubic prostatectomy and 2 followed transurethral prostatectomy. Most of the cases previously reported followed cystostomy or suprapubic prostatectomy.

Roentgenographic changes in the pubic bone include a periosteal reaction beginning about three weeks after the onset of symptoms and followed by spotty demineralization and destruction of bony trabeculae. Separation of the symphysis occurs, and after healing there may be hypertrophic changes at the symphysis, and even ankylosis. Sequestration is rare.

Inflammation, ischemia, and dystrophia have been considered to be the etiological factors in this entity. The authors believe infection by bacteria of low virulence to be the primary factor. The presence of urine in the retropubic space may act as an additional irritant.

Treatment is mainly supportive and symptomatic. Chemotherapy and antibiotics have not proved of value. The disease is self-limited, with a duration of from two months to two years.

Six roentgenograms; 1 table.

DOUGLAS B. NAGLE, M.D.
University of Pennsylvania

Knee Joint Changes after Meniscectomy. T. J. Fairbank. J. Bone & Joint Surgery **30-B:** 664–670, November 1948.

This paper is a report of the findings in 107 cases of meniscectomy determined by examination of preoperative and postoperative roentgenograms. Cases with osteoarthritic changes were excluded.

Three types of changes in the joint were noted after meniscectomy: (1) formation of an anteroposterior ridge projecting downward from the margin of the femoral condyle over the old meniscus site; (2) generalized flattening of the marginal half of the femoral articular surface; (3) narrowing of the joint space on the side of the operation, occasionally accompanied by widening of the joint space on the other side. The femoral ridge was noted in some cases in apparently normal joints and before meniscectomy. The narrowing of the joint space and flattening of the femoral condyle were most commonly found together.

The author suggests that these changes are the result of a loss of the weight-bearing function of the meniscus. Since it is not generally accepted that the meniscus is weight-bearing, he emphasizes the two points of his investigations which led him to this conclusion. The first is that there is a restraining force to prevent the meniscus from slipping out from under the weight thrust upon it; the second, that articular cartilage is perfectly elastic only for small loads over a short period of time.

Roentgenograms were made at various times during the day with different degrees of compression at the joint. As compression increases, the circumference of the meniscus is forced centrifugally; the greater the compression the greater the circumferential tension in the meniscus. This tension, because it resists extrusive forces, enables the meniscus to share in weight bearing.

Meniscectomy, therefore, results in overloading the articular surfaces, with increasing compression of cartilage. Since the method of replacement of the loss of articular cartilage from normal wear and tear is in doubt, the author suggests that the role of the meniscus in lubrication and the prevention of friction and maintenance of nutrition is important in the development of narrowing of the joint space.

Individual variation with respect to the findings after meniscectomy may depend on two factors: (1) variations in the reserve or safety factor of joints, and (2) variations in speed and completeness of regeneration of the meniscus.

Eleven roentgenograms; 9 drawings.

JOHN R. HODGSON, M.D.
The Mayo Clinic

Patella Cubiti: A New Method of Treatment for Its Avulsion. Joseph Sachs and George Degenshein. Arch. Surg. **57:** 675–680, November 1948.

Patella cubiti is a condition of the elbow joint wherein a patella-like bone lies proximal to the olecranon process within the investments of the triceps tendon. First described by anatomists in 1776, it has rarely been reported. Whether it is a simple congenital anomaly or is due to trauma has been a subject for debate. Although the former hypothesis has considerable support, Habbe (Am. J. Roentgenol. **48:** 513, 1942. Abst. in Radiology **40:** 534, 1943) published a case in which the traumatic origin is well authenticated. Since the condition is asymptomatic, its discovery is usually incident to roentgen study for other reasons.

Avulsion of the patella cubiti, however, presents a definite clinical picture; there is usually a history of an extension force on the elbow, followed immediately by pain and loss of the power of extension. A moderate-sized bony fragment is palpable posterior to the lower end of the humerus. Although the fragment is

movable, it cannot be pulled down as far as the elbow joint. Roentgenograms show the avulsed sesamoid lying 1 or 2 cm. from the olecranon, as contrasted to its immediate contact with the olecranon when intact. The bony edges are smooth. The most important criterion is the fact that the combined length of the ulna and sesamoid exceeds that of the normal ulna or, if the condition is bilateral, exceeds the expected length of the ulna as estimated from the radius. Treatment by screwing the sesamoid to the ulna without destruction of the joint surface is advocated. A case so treated with excellent results is reported.

Six roentgenograms. LEWIS G. JACOBS, M.D.
Oakland, Calif.

Etiology of Peroneal Spastic Flat Foot. R. I. Harris and Thomas Beath. J. Bone & Joint Surg. **30-B:** 624–634, November 1948.

Peroneal spastic flat foot is a type of rigid flat foot accompanied by contraction of the peroneal muscles. The usual concept of the condition has been that of a weak but flexible flat foot transformed into a rigid flat foot by peroneal spasm induced by painful stimuli arising from the tarsal joints. The authors point out numerous objections to this idea. Electromyographic studies in many cases demonstrate no spasm in the peroneal muscles, while measures to eliminate the supposed effect of the peroneal muscles do not alter the deformity.

The authors believe that most cases of so-called peroneal spastic flat foot are caused by tarsal anomalies. The two most frequent anomalies are the calcaneonavicular bar described by Sloman in 1921 and by Badgley in 1927, and the talocalcaneal bridge.

The incidence of peroneal spastic flat foot among 3600 men undergoing examination for Canadian Army service was found to be 2 per cent. In 12 of the authors' 17 cases there was a bridge of bone springing from the medial surface of the talus, spanning the subtalar joint, and meeting a mass of bone from the medial surface of the calcaneus at the posterior end of the sustentaculum tali. Of the remaining 5 patients, 3 had calcaneonavicular bars and 2 tarsal rheumatoid arthritis.

The talocalcaneal bridge is not easily recognized in the ordinary roentgenographic projections of the foot. Some suspicion of the presence of the anomaly may be obtained from the lateral roentgenogram, which shows marginal lipping of the talonavicular joint on its dorsal surface. Roentgenograms to demonstrate the condition are made with the feet together, the central x-ray beam being projected downward and forward at an angle of 45 degrees through the heels, which have been freed of the leg shadow by flexing the knees.

In the rigid flat foot due to talocalcaneal bridge, the partial fixation of the talus to the calcaneus interferes with normal freedom of movement, with impingement of the articular margins of the talus and navicular and osteoarthritic lipping of the superolateral margin of the head of the talus.

The rigid flat foot caused by calcaneonavicular bar may or may not cause symptoms. There is fusion of the anterior process of the calcaneus to the navicular.

The arthritic flat foot with peroneal spasm is produced by fixation of the joints in abnormal position with valgus deformity and secondary peroneal spasm. This is a distinct group separate from the flat foot caused by tarsal anomalies.

Treatment is largely a medical problem but certain orthopedic procedures are of definite value.

Twenty-one illustrations, including 14 roentgenograms. JOHN R. HODGSON, M.D.
The Mayo Clinic

Bone Formation in Skin and Muscle. A Localized Tissue Malformation or Heterotopia. Henry W. Edmonds, Herbert E. Coe, and Frank L. Tabrah. J. Pediat. **33:** 618–623, November 1948.

This is the fourth case of bone formation in the soft tissues reported in the literature. The patient was a child of three and a half years. At the age of one month a small, hard, irregular area had been discovered near the left breast. At five months a red non-tender lump on the tip of the left second finger, thought to be a splinter, was noticed and treated with hot packs. In the sixth and seventh month masses developed in the left axilla, left forearm, and left hand. When the patient was eighteen months old, the lump at the tip of the left second finger was surgically explored and a calcareous deposit removed. Other masses developed in the left middle finger and on the crown of the head. When the patient was first seen by the authors, x-ray examination showed calcifications in the soft tissues of the left axilla, arm, forearm, hand, and fingers and a destructive process involving the distal end of the left ulna with some periosteal reaction. Films of the right arm, skull, and pelvis showed no abnormality. The masses were removed from the left hand, forearm, upper arm, axillary fold, and chest wall and were found to be imbedded in all types of soft tissue. They were white in appearance and varied in size and thickness. No recurrences were noted following removal.

Microscopic examination showed that these masses were not amorphous calcium but were actually mature bone situated within the dermis and subcutaneous tissue, fascia, and muscle. This bone was normal in appearance and contained haversian systems. There were no cartilage inclusions and no neoplastic or inflammatory processes.

The authors briefly review three other cases reported in the medical literature quite similar to the present one.

This condition has been given various names: osteosis of the skin, osteoma cutis, congenital osteomas of the skin. The authors believe that it is actually a heterotopia, *i.e.*, formation of normal tissue at an abnormal site.

Two roentgenograms; 1 photograph; 2 photomicrographs. EUGENE KUTZ, M.D.
Baltimore (Md.) City Hospitals

GYNECOLOGY AND OBSTETRICS

Amniography. J. Lefebvre, A. Granjon, and A. Méric. J. de radiol. et d'électrol. **29:** 601–605, 1948. (In French)

The authors describe briefly the technic of amniography. Perabrodil and diodrast are satisfactory contrast media. A long fine needle such as is used for spinal puncture is employed, and an amount of amniotic fluid equal to the quantity of the contrast agent to be injected is withdrawn. The exact site of puncture is not mentioned, nor is the amount of material to be injected.

The procedure permits the localization of the placenta, demonstration of uterine and fetal anomalies, diag-

nosis of uni-amnionic twins, and in some instances determination of sex. By taking a series of roentgenograms, an outline of the renal pelves and the bladder may be obtained within an hour.

Hydramnios often accompanies fetal abnormalities, and has been used as an indication for amniography.

Eight roentgenograms. CHARLES NICE, M.D.
University of Minnesota

THE GENITO-URINARY SYSTEM

Double Formations of the Pelves of the Kidneys and the Ureters. Embryology, Occurrence and Clinical Significance. Bengt Nordmark. Acta. radiol. **30:** 267–278, Nov. 30, 1948.

Most embryologists consider that any division of the kidney pelvis beyond an upper and lower calyx major must be regarded as anomalous. In double formation of the kidney pelvis there is, as a rule, a smaller upper pelvis and a larger lower pelvis. These may possess a common ureter or the ureter may also be duplicated at any point between the kidney pelvis and the bladder. When the ureters are separate at the bladder, that from the upper pelvis usually enters the bladder below and medial to the ureter from the lower pelvis. Supernumerary ureters may not enter the bladder, but may empty into the urethra or vagina. Duplication of the pelvis and ureters may be unilateral or bilateral. Occasionally triple division may exist.

The embryological explanation of duplication is as follows: the anlage of the secreting portion of the kidney develops as mesodermal cell tissue from the nephrogenous cord. At the same time, a ureter bud develops from the proximal end of the wolffian duct. The ureter bud grows toward the nephrogenous cell tissue and its end widens out and divides into two great branches, the future greater calices. At the same time, the nephrogenous cell tissue grows and covers these branches like a cap. Premature division of the ureter bud at any point between the wolffian duct and the nephrogenous tissue will result in an anomaly, varying from cleft kidney pelvis to complete reduplication.

The frequency of reduplication of the pelvis and ureter is reported as 2 to 4 per cent in cystoscopic and pyelographic series. The author reviewed 4,774 cases studied urographically and found 201 cases of double kidney pelvis (4.2 per cent), in 138 of which there was also duplication of the ureter (2.8 per cent). Though the condition is generally regarded as more common in women, there was a slight predominance of males in his series, 103 to 98. The anomaly was more often unilateral than bilateral, and occurred somewhat more frequently on the left side.

As to the roentgen aspects, the author says: "In divided kidney pelvis, the caudal part may present exactly the same appearance as an undivided pelvis. One must always accurately demarcate the kidney and calculate if the pelvis filled by contrast is large enough to serve for the whole kidney . . . . One must not therefore conclude that a urograph is normal because the configuration of the pelvis on both sides is normal."

These malformations are important because they are frequently accompanied by dynamic disturbances resulting in stasis and infection. Furthermore, the supernumerary ureters often end ectopically, causing continuous incontinence of urine. Heminephrectomy can be carried out if changes are localized in one kidney pelvis, thus saving much serviceable kidney parenchyma.

Ten roentgenograms; 4 drawings.

RICHARD L. MASON, M.D.
Cleveland Clinic Foundation

Urethrograms and Cystograms in the Diagnosis of Lower Urinary Tract Disease. Russell B. Roth. Pennsylvania M. J. **52:** 130–134, November 1948.

The ease with which the urethra and bladder may be explored endoscopically has led many physicians to forego the use of cysto-urethrography. This is a mistake, because a great deal of information can be obtained by the use of various contrast media and technics.

The investigator must first know what he is looking for, and a close cooperation between the urologist and the radiologist in matters of technic, positioning, and opaque media will be productive of much more information than that gained by merely placing sodium iodide in the bladder. As an example: in excretory urography if one delays taking a film of the bladder until the patient has a desire to void and then takes a film after voiding, in the erect position, an excellent visualization of the amount of residual urine will be obtained.

The author shows films obtained in oblique positions to reveal diverticula. He also demonstrates the visualization of diverticula of the bladder with air and sodium iodide. Vesical neck contracture is well demonstrated by the use of lipiodol-tragacanth jelly, and old abscess cavities are shown in films made in the oblique position while the patient is voiding and attempting to void.

Sixteen roentgenograms.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

RADIOTHERAPY

Report from the Mozelle Sassoon Department, St. Bartholomew's Hospital, London. The Million-Volt X-Ray Plant: Its Development and Application. G. S. Innes. Proc. Roy. Soc. Med. **41:** 691–703, October 1948. **Clinical Reactions and Injuries in Supervoltage Therapy.** Arthur Jones. Ibid. 703–709. **Million-Volt X-Ray Therapy.** I. G. Williams. Ibid. 709–718. **Million-Volt X-Ray Research at St. Bartholomew's Hospital.** N. S. Finzi. Ibid. 719–720.

Innes describes the million-volt x-ray plant at St. Bartholomew's Hospital in London and discusses the physical advantages of million-volt radiation over the usual 250 kv. With 1,000-kv., an increase in depth dose is obtained with reduction in the skin reaction. Fewer fields are required to deliver the required dose, resulting in a simplified treatment plan which leads to a gain in accuracy. It is possible to reduce the dose to fields passing through susceptible organs, attaining the necessary tumor dose by a less efficient routing of the beam to the lesion. In nearly all cases 6,000 r can be delivered to the lesion within five weeks no matter how large the patient may be. Bone absorption at 1,000 kv. is little greater than tissue absorption.

Jones points out that in the "deep-therapy" range of x-rays the factor limiting treatment is often the skin reaction, but that the penetrating properties of million volt therapy may produce a deep mucositis in the tumor region and thus limit the amount of radiation given. This is best seen in the mouth, pharynx, and larynx, and in the pelvis. Considering the extent of lesions and the tumor dose given, it is concluded that general reactions are less severe than in the ordinary deep therapy range. Injuries have been relatively rare with the apparatus at St. Bartholomew's. Those that have been observed are discussed in some detail.

The results of million-volt therapy are discussed by Williams, who concludes that lesions which respond poorly to ordinary x-ray therapy cannot be expected to show marked response to rays generated at a million volts, with the possible exception of carcinomas of the rectum, bladder, antrum, and larynx. There is no evidence of any biological difference in response due to the shorter wave lengths used. Any improvement in results is due to the physical advantages of greater penetration and greater accuracy due to ease of application.

The research aspects of higher voltage are presented by Finzi. It is his opinion that "the million-volt machine already shows a definite advance and indicates that malignant disease should be treated by higher voltages still."

Seventeen illustrations. EDSEL S. REED, M.D.
University of Louisville

Investigations into Differentiation and Other Morphological Changes in Malignant Tumours Following Therapeutic Irradiation with X-Rays and Radium. S. Ry Andersen. Published by Einar Munksgaard, Copenhagen, 1949. 112 pp.

This monograph on the pathologic changes in malignant tumors of man and animals following therapeutic irradiation is a treatise for the doctorate at the University of Copenhagen. It is translated into English and consists of an introduction and eleven chapters, the last of which contains the conclusions and summary in both English and Danish. The question has often been raised as to whether irradiation has the power to produce differentiation or "ripening" in malignant tumors. This work is thorough and exhaustive on the subject of differentiation or lack of it as found in both human and animal malignant tumors following irradiation by the usual clinical technics.

A careful survey of the earlier investigations bringing the information down to date is followed by details of the author's numerous investigations. He studied squamous-cell carcinoma, mammary carcinoma, spindle-cell sarcoma and chondrosarcoma transplantable in mice. In the human being he studied skin carcinoma, mammary carcinoma, and carcinoma of the cervix.

He concluded that therapeutic irradiation of a number of suitable malignant tumors with x-rays or radium was not followed by histologically demonstrable changes interpretable, with our present knowledge of morphology, as criteria of differentiation. In his opinion, the dosage used in clinical radiotherapy should not be adapted to alterations, if any, in the differentiation during or after the irradiation, because he does not consider these a fit standard for foretelling the tumor response to the radiation.

Those pathologists, radiologists, and radiobiologists who are interested in morphologic cellular changes produced by radiation will find this extensive study well worth reading.

Twenty-eight photomicrographs.

HAROLD W. JACOX, M.D.
New York, N. Y.

Radium Treatment of Carcinoma of the Tonsil. E. Maier. Radiol. Austriaca **1:** 77–83, 1948. (In German)

Forty-seven patients with squamous-cell carcinoma of the tonsils were treated in the Krankenhaus der Stadt Wien in 1933–34, by implantation of 1.3 to 2 mg. of removable radium needles with 0.5 mm. platinum filtration, left in place for 72 to 144 hours. The distribution of the needles was such that each cubic centimeter of tissue received about 133 mg. hours. After eight to ten days teleradium treatments were added in all cases, given in twenty-six to thirty days with a tumor dose of between 4,400–5,000 r. Of all patients 25.5 per cent were alive for five or more years. A block dissection of cervical nodes was done only when there was evidence of remaining disease two months after completion of the irradiation. Of 36 patients with involvement of lymph nodes only 4 were well for five years or more.

One drawing; 3 tables. H. W. HEFKE, M.D.
Milwaukee, Wis.

Primary "Inflammatory" Carcinoma of the Breast. Bernard A. Donnelly. Ann. Surg. **128:** 918–930, November 1948.

Two clinical varieties of inflammatory carcinoma of the breast exist: *primary*, in which the inflammatory signs arise simultaneously with carcinoma in the skin of a previously normal breast, and *secondary*, in which inflammatory signs arise suddenly in a breast that has long been the seat of scirrhous carcinoma, or in the opposite breast, or follow mastectomy for carcinoma, either at the original site or in the opposite breast. The clinical course and behavior of the two types are similar.

The incidence of primary inflammatory carcinoma of the breast is between 1.3 and 4.2 per cent of all mammary carcinomas. The age incidence is said to be similar to other types; in the author's 5 cases the average age was fifty-six years. There is no real pathologic evidence of inflammation and there are usually no clinical signs indicative of true inflammation. The involved breast is usually enlarged, dark red or purplish in color, tender and warmer than the opposite breast. This is explained by the diffuse infiltration of the undifferentiated carcinoma cells through the lymph vessels and capillaries, producing edema, reddening, and heat. The round-cell infiltration, often noted, is due to blockage of the lymphatics and not to inflammation. The spread of the carcinoma is subdermal rather than intradermal as in Paget's disease.

The patient first notices heaviness and pain in the breast, varying from dull ache to intermittent shooting pain. Skin discoloration and increase in size of the breast follow. Often, when seen at this stage, the process is mistaken for an acute inflammatory one and treated accordingly. Of the 5 cases reported here, 4 were thus treated before being referred to the author. To avoid loss of valuable time he recommends incisional biopsy when inflammatory signs about the breast do not subside within two or three weeks.

True inflammatory lesions of the breast are usually accompanied by fever, leukocytosis, and other signs of general inflammation rarely found with "inflammatory" carcinoma. *Erysipelas* is rare in this region, is more fulminating, and is accompanied by prostration with high fever and marked leukocytosis. *Paget's disease* involves the skin of the nipple, areola, and surrounding area and presents a reddened granular surface, discharging yellow viscid fluid or may appear as chronic eczema with encrustations. The lesion is frequently confined to the areola alone, and the nipple disappears as the disease progresses, while in inflammatory carcinoma the nipple is usually not involved other than showing evidence of retraction. *Plasma-cell mastitis* shows the signs and symptoms of a diffuse inflammation radiating from the nipple which will subside in from a few days to a week, leaving a firm irregular tumor. *Tuberculosis of the breast* is slow in onset and presents a soft tumor with redness of the overlying skin and later areas of softening. The skin later thins out over the soft areas, and multiple sinuses develop. There is usually evidence of tuberculosis elsewhere. *Hodgkin's disease* can produce a picture identical to that of inflammatory carcinoma and is distinguishable only by biopsy.

Metastasis occurs early in inflammatory breast carcinoma with axillary involvement in the majority of cases and distant metastases in many.

Regardless of the type of treatment used, the prognosis is poor. The 5 patients reported on all received roentgen therapy. One improved enough to warrant radical mastectomy with fairly good primary results, but recurrence ensued nine months later. Another responded to radiation, but at operation distant metastases were discovered. The other three showed little response to radiation given intensively. Testosterone produced fair palliation in some. Three patients died at thirteen, nineteen, and nineteen months after onset. Two were alive with the disease, at the time of the report, nineteen and twenty-one months after onset.

Five illustrations. BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Palliative Testosterone Treatment in Women with Advanced Breast Cancer. Bengt Sylvén and Olle Hallberg. Acta radiol. **30:** 395–414, Nov. 30, 1948.

Women with metastases from mammary cancer usually experience symptomatic improvement on androgen therapy as evidenced by a gain in weight and a sense of well being. In patients with skeletal metastases this is often associated with relief of pain and occasional recalcification of osteolytic lesions. Neither the primary tumor nor soft-tissue metastases are consistently benefited by such therapy.

Testosterone propionate is the androgen of choice. Under varying conditions it was administered intramuscularly, by pellet implanation, orally, or as an inunction. Most patients received 50 mg. daily for two to six weeks until subjective improvement was noted or relief of pain obtained. The lowest total dose giving this improvement was 600 mg. in three weeks, but most patients required 1,200 to 1,500 mg. over a six-week period for initial palliation, followed by a maintenance dose of 150 mg. weekly. In some cases with progressive skeletal involvement, pain which reappeared with subsequent metastatic foci responded satisfactorily to increased dosage. The authors state that an excessively elevated serum calcium level, present initially or appearing during course of treatment, is the only contraindication to androgen therapy. No untoward effects have been noted other than the expected virilizing symptoms.

The physiological action of androgens on protein anabolism with production of a positive nitrogen balance may partially explain the symptomatic relief. It is also suggested that androgen therapy may increase the threshold value for pain in those with skeletal lesions by central nervous system action. It is very doubtful whether androgens have direct cancerocidal effect. Since androgen therapy has produced systemic improvement in patients debilitated from undernutrition and "other severe diseases," the authors feel its palliative value should be explored in additional malignant conditions, especially in women.

Most of the 38 cases upon which this report is based had been treated by radical mastectomy and postoperative roentgen therapy (no technical details). Five moderately debilitated women had had Stage I and II lesions without evidence of distant metastases. They experienced symptomatic improvement following administration of testosterone propionate as evidenced by improvement in appetite and weight and an increased sense of well being. They had been followed only eight months.

A second group of 10 women with breast cancer disseminated mainly to viscera was not beneficially affected.

Twenty-three patients with metastases limited mainly to the skeletal system form the basis for a more optimistic outlook. This group included younger women castrated by irradiation as well as women past the climacteric. No significant difference in response of these subgroups was noted. On testosterone therapy 18 patients showed moderate to marked improvement which had persisted an average of eight months. The remaining 5 were improved for varying lengths of time up to seven months.

Increased calcification in osteolytic lesions without appearance of new foci was roentgenographically demonstrated in 20 per cent of the women previously castrated by irradiation and 30 per cent of those past the normal climacteric. Approximately 75 per cent of women with skeletal metastases will develop new osteolytic foci while under testosterone therapy despite subjective improvement.

Laboratory examinations in women with bone involvement showed no change in serum-phosphorus levels during androgen therapy. The serum calcium, slightly elevated before treatment, was reduced to 8 or 9 mg. per cent irrespective of whether osteolytic lesions recalcified. A steep rise in serum calcium may signify increased growth activity of cancerous deposits. Cases responding favorably to androgen therapy showed increased alkaline phosphatase levels of 10 to 20 units irrespective of appearance of new osteolytic lesions. Values of 5 to 10 units were found in uninfluenced cases.

The authors present survival statistics from the Radiumhemmet for 167 women with mammary carcinoma receiving palliative irradiation for skeletal involvement without androgen therapy. Two years after onset of bone lesions 27 per cent in the premenopausal castrated group were alive, 17 per cent in a similar non-castrated group, and 10 per cent in the post-menopausal group. Only 3 to 5 per cent were

living after five years. We are reminded that skeletal involvement is a manifestation of generalized carcinomatosis, but the length of survival depends more on the extent of visceral metastasis.

Androgen therapy has brought no case under complete control. It has not produced hypercalcification of skeletal foci as seen in prostatic metastases under estrogen treatment. Nor has it produced the high degree of radiopacity occasionally seen in irradiated osteolytic metastases from breast cancer.

The authors agree that a final judgment as to the influence of androgens on skeletal metastases from mammary carcinoma in women must await a two- or three-year follow-up.

Eleven roentgenograms; 1 photograph; 5 tables.

ALBERT A. RAYLE, JR., M.D.
Cleveland Clinic Foundation

Control of Cancer of the Uterus. Report of a Ten Year Experiment. Catharine Macfarlane, Margaret C. Sturgis, and Faith S. Fetterman. J. A. M. A. **138:** 941–942, Nov. 27, 1948.

In 1938 and 1939, 1,319 white women, thirty to eighty years of age, presumably well, volunteered to submit to pelvic examination twice a year for five years. At the end of that time, it was decided to continue the examinations, and the authors now report on 732 of the number who have been examined more or less regularly over a ten-year period.

Three cancers of the cervix were discovered at the initial examination; all were treated with radium and showed no evidence of recurrence nine years after treatment. Only one cancer of the cervix was found after the first visit. One adenocarcinoma of the body of the uterus was discovered at the initial examination and another on microscopic examination of a uterus removed for fibroids. One ovarian cancer and one carcinoma of the vaginal wall were encountered in the course of the ten-year period.

Eight hundred and sixty-eight benign lesions were discovered, including 489 inflammatory lesions of the cervix. Of the latter, 214 were eliminated by appropriate treatment, and it is believed that this accounts, in part, for the low incidence of cervical carcinoma in the series.

Five tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

On the Choice of Treatment of Individual Carcinomas of the Cervix Based on the Analysis of Serial Biopsies. Alfred Glucksmann and Stanley Way. J. Obst. & Gynaec. Brit. Emp. **55:** 573–582, October 1948.

Experience has shown that occasionally even an early case of carcinoma of the cervix treated with radiation recurs locally within a year or two. In other cases treated by radical surgery, while the results are good, it is by no means certain that such results could not have been achieved with radium at less risk to the patient. In 1945 Glucksmann and Spear (Brit. J. Radiol. **18:** 313, 1945. Abst. in Radiology **47:** 207, 1946) described a cell-count technic of determining whether or not the response of a tumor to irradiation is favorable, thus offering a rational basis for selecting patients who would be unsuitable for radiotherapy alone and who might be salvaged by surgery.

During the period under review (December 1946 to June 1948) 149 cases were studied by this method. The staging criteria were as follows: Stage I, tumor limited to the cervix; Stage II, tumor invading the vaginal vault and/or extending into one or both broad ligaments, but extension not fixed to the pelvic wall; Stage III, invasion of the lower third of the vagina and/or extension into one or both broad ligaments, with fixation to the pelvic wall; Stage IV, invasion of the bladder or rectum, or remote metastases.

The method of irradiation used at first was a modification of the Stockholm technic, with two equal doses separated by an interval of seven days. The dose received on the surface of the tumor was not less than 10,000 r and often more than 13,000 r. Since November 1947 a three-dose technic has been used, with an interval of a week between the first and second, and two weeks between the second and third applications. The total dose has remained the same.

The radical operation consists of removal of the uterus, fallopian tubes, and ovaries, and the upper nine-tenths of the vagina, the broad ligaments, the pelvic connective tissue, and the lymph nodes lying along the course of the external and internal iliac vessels and the obturator nodes. If these nodes are obviously involved, the dissection is carried up to the aortic bifurcation if necessary.

The present procedure is as follows: The patient is examined under anesthesia and the tumor staged, the preliminary biopsy is taken, and the first application of radium given. A week later a second biopsy is taken and the second application of radium given. During the following two weeks the histologic analysis is made and the prognosis obtained. If the prognosis is favorable, the third application of radium is given, followed two weeks later by bilateral iliac adenectomy. In a series of 10 cases thus treated only 1 showed node involvement.

If the prognosis with radiotherapy is unfavorable and the case is suitable for radical surgery, no further radium is given and a radical hysterectomy is performed six weeks later. If, however, the prognosis is unfavorable and the tumor is inoperable, a further application of radium is given but iliac adenectomy is not done.

Of the 149 cases studied, 54 gave a favorable or probably favorable response to the test dose of radiation; 88 gave an unfavorable response, and in 7 the biopsy material provided was inadequate. In the 54 favorably responding cases, radium alone was used in the treatment of the primary tumor, but in a small number the regional lymph nodes were removed surgically. Of the 88 unfavorable cases, 46 were initially considered suitable for Wertheim's hysterectomy, which was completed in 28 cases.

In 37 cases with unfavorably responding tumors in which the pelvic lymph nodes were examined microscopically, tumor tissue was present in 25. In 22 of these patients the primary tumors were in clinical Stages I and II, and the remainder in Stage III.

Though in patients with radio-incurable cancer of the cervix, the high incidence of lymph node involvement and the comparatively low operability rate must limit the success of radical surgery, it is at present the only effective means of dealing with this type of tumor.

Four photomicrographs; 4 tables.

Treatment of Carcinoma of the Cervix Uteri. A. Maxwell Evans. Canad. M. A. J. **59:** 458–462, November 1948.

The author reviews the literature on the treatment of carcinoma of the cervix and presents the results obtained

at the British Columbia Cancer Institute, where radium plus external radiation is used.

Twenty-five cases of Stage I (League of Nations) were treated, with 21 patients surviving over five years; 38 cases of Stage II, with 13 surviving over five years; 32 cases of Stage III, with 4 surviving over five years; 31 cases of Stage IV with 2 surviving over five years.

Two illustrations; 3 tables.

JOHN DECARLO, JR., M.D.
Jefferson Medical College

Interstitial Placement of Radium as Adjunct to the Radium Therapy of Carcinoma of the Cervix. Carl Fried. Radiol. clin. **17:** 333–347, November 1948. (In German)

The use of radium needles in the treatment of carcinoma of the cervix has not been popular in the past, but there is a tendency now to use this method more frequently. While the placement of radium needles in the parametrium is a dangerous procedure, their use within the cervix and the paracervical tissues can be recommended.

Fried gives a rather detailed description of the various methods used in interstitial radium therapy, citing Ward and Sackett (J. A. M. A. **110:** 323, 1938), who reported 56.2 per cent five-year survivals and 38.5 per cent ten-year survivals for cases of Grades 1 and 2, after interstitial radium and deep therapy; Waterman and DiLeone (Am. J. Obst. & Gynec. **50:** 482, 1945. Abst. in Radiology **47:** 316, 1946), and Covington (Surg., Gynec. & Obst. **82:** 512, 1946. Abst. in Radiology **48:** 316, 1947), and others. His own technic he describes by reporting a case. The patient was a woman of fifty-one with a Grade 3 carcinoma of the cervix and involvement of the parametria. Treatment was given by means of radium element needles and capsules, intracervically and intravaginally, for a total dose of 5,762.4 mg. hours. The patient was well after two years and eleven months. Diagrams illustrate the placement of the capsules and needles. Although Fried has not sufficient cases to report to justify a general appraisal, he believes that interstitial radium therapy is in selected cases a good adjunct. It will be helpful mainly in carcinomas of Grades 3 and 4, with cauliflower ulcerations or obliterations of the cervical canal. The danger of this therapy is neglible.

Four illustrations.

EUGENE F. LUTTERBECK, M.D.
Chicago, Ill.

Results of Treatment of Carcinoma of the Ovary with Data on the Age Incidence of This Disease. Joseph H. Marks and Martin H. Wittenborg. Surg., Gynec. & Obst. **87:** 541–545, November 1948.

The authors report a series of 79 cases of carcinoma of the ovary seen in the Department of Roentgenology of the New England Deaconess Hospital during the ten-year period beginning in June 1936. Fifty-seven of these patients have now been followed to death. Of the original group, 14 were alive more than five years after their first operation and treatment, but 3 of this number have since died of their disease, and one is alive after five and a half years with recurrent disease. Not all of the patients have as yet had an opportunity to live five years after treatment, but the five-year survival rate calculated by the method of Nathanson and Welch is 21 per cent.

The original plan of treatment almost always called for 1,800 r (measured in air) per port whether or not the beams were cross-fired, but modifications of the plan were frequently required as the series progressed. In one more or less typical case 1,900 r were given to each of two anterior and two posterior pelvic ports, with 1,500 roentgens to each of two upper abdominal ports. Ports measured 15 × 15 centimeters. Six weeks later the patient was given a second series of x-ray treatments, through the same six ports and with the same factors. Not all patients received this quantity of radiation. Treatments were given at 400 kv., with 50 cm. target-to-skin distance and with a filter of 0.9 mm. tin, 0.25 mm. copper, and 1.0 mm. aluminum. The normal daily dose was 300 roentgens to a single port, and treatments were given daily except Sundays.

The authors conclude that x-ray therapy should be employed in all cases of carcinoma of the ovary, that it is excellent insurance postoperatively even when the surgeon believes that all disease has been removed, and that it may occasionally result in cure even in advanced stages of the disease. They believe that the surgeon should not take too great risk in his attempt to remove the last fragments of diseased tissue, but should remove the easily accessible masses and then rely on x-ray therapy in adequate dosage, and through whatever ports may be necessary, to cover the involved areas. X-ray therapy may bring about gratifying palliation even when cure is not obtained. It often gives relief of pain and causes a retardation of the production of peritoneal and pleural fluids.

A study of the age incidence of ovarian carcinoma was made in connection with this investigation. It was found to be unlike that of most malignant epithelial tumors, in that a decrease occurs after the sixth decade.

Three charts.

MARLYN W. MILLER, M.D.
University of Pennsylvania

Treatment of the Leukemias. George L. Kauer, Jr. Am. J. M. Sc. **216:** 581–595, November 1948.

The recent literature on the treatment of leukemia is reviewed, with sections on the use of the nitrogen mustards and other chemical compounds, roentgen therapy, and the radioisotopes.

There is no evidence that any cures of leukemia have been effected. It is possible occasionally to induce temporary and partial remissions in the acute form of the disease by the use of aminopterin, nitrogen mustard, or crude myelokentric acid (in lymphoblastic leukemia). The chemotherapeutic agents of use in chronic myelogenous leukemia are Fowler's solution, urethane, and possibly benzol. Chronic lymphogenous leukemia responds seldom to Fowler's solution, and to urethane less well than the myelogenous form. Nitrogen mustard may be of value in the chronic leukemias, especially when they have become radioresistant. The data indicate that radiation therapy is still the most effective form of treatment, but that it is of little or no value in the acute form of the disease. Splenic irradiation in the chronic myelogenous form, and total body irradiation, "spray" to the torso, or direct irradiation of the enlarged lymph nodes are the technics of choice for roentgen therapy in the chronic lymphogenous diseases. Radiophosphorus is apparently as good as roentgen irradiation in chronic myelogenous leukemia, but is probably not quite as effective as the latter in chronic lymphogenous leukemia.

A bibliography of 89 references is appended.

Hemangioma (Capillary and Cavernous) with Thrombopenic Purpura. Report of a Case with Observations at Autopsy. Henry K. Silver, Paul M. Aggeler, and Jackson T. Crane. Am. J. Dis. Child. **76:** 513–520, November 1948.

This is the third reported case of extensive hemangioma of the skin associated with thrombopenic purpura. The patient, an infant girl, had had superficial hemangiomas appearing on the neck, face, and abdomen since birth. These responded to treatment with solid carbon dioxide. At five months of age a diffuse racemose angioma appeared on the back. This receded temporarily after roentgen therapy but gradually hemangiomas developed on the neck, chest, abdomen, and arms. Eventually hemorrhage occurred from the hemangiomas, and the liver and spleen became palpable. At twenty months of age, thrombopenia appeared. A large hemothorax developed and death ensued.

Microscopic examination of the skin, muscle, and lymph nodes showed both the capillary and cavernous types of hemangioma, with predominance of the latter. The bone marrow showed extreme hyperplasia, with increase in megakaryocytes and erythropoietic tissue.

The predominance of the cavernous type of hemangioma may have accounted for the lack of response to roentgen irradiation. The thrombopenia was probably due to the failure of the megakaryocytes to produce a sufficient number of platelets.

One illustration. PAUL W. ROMAN, M.D.
Baltimore, Md.

Ringworm of the Scalp in the Eastern Region of Scotland, 1946–47. J. Kinnear and John Rogers. Brit. M. J. **2:** 854–858, Nov. 13, 1948.

A brief review of ringworm of the scalp in Europe and the United States is presented and two epidemics in Eastern Scotland are analyzed. Of 631 cases, 98.4 per cent represented Microsporon infections; 84.15 per cent of those infected were boys. It is believed that most of the infections occur in barber shops.

Epilation by x-rays or thallium is still the most rapid and successful means of cure, but fungicides assisted by a wetting agent in carbo-wax 1500 offer some benefit in a fair proportion of cases. The technic of epilation, whether by x-rays or thallium, is not discussed.

A brief note is included regarding the organization required for a center to deal with cases of ringworm and the standards necessary for insuring that patients are non-infectious before their return to school.

Three tables. JOS. D. CALHOUN, M.D.
University of Arkansas

Irradiation of Lymphoid Tissue in Diseases of the Upper Respiratory Tract. Donald F. Proctor, Leroy M. Polvogt, and Samuel J. Crowe. Bull. Johns Hopkins Hosp. **83:** 383–428, November 1948.

The authors discuss in considerable detail the physiological functions of the upper respiratory tract, pathology of upper respiratory infections, and the clinical considerations. They state that in the majority of patients the following results may be expected from irradiation of nasopharyngeal lymphoid tissue: (1) improvement in hearing or cessation of progressive impairment when the symptoms are due to interference with the function of the eustachian tubes; (2) marked decrease in the number and severity of upper respiratory infections, including acute infections in the sinuses, ears, and tonsils; (3) improvement in many patients, especially children, suffering from bronchial asthma, when the asthma is on an infectious basis and when other forms of therapy such as desensitization are also employed. In the authors' experience not a single instance of burn or other complication due to the use of radium has been observed.

Twenty-two illustrations and charts.

Observations on the Excessive Nocturnal Gastric Secretion in Patients with Duodenal Ulcer. Joseph B. Kirsner, Erwin Levin, and Walter Lincoln Palmer. Gastroenterology **11:** 598–615, November 1948.

The authors present in detail 5 cases of duodenal ulcer, with special reference to nocturnal gastric secretion. They found that the output of hydrochloric acid was not affected by atropine in doses up to 6.0 mg. Enterogastrone also failed to decrease nocturnal secretion in the 3 cases in which it was used. Irradiation of the fundus and body of the stomach, although effective in reducing the acid output in some peptic ulcer patients, was erratic in its results. Of the 4 patients in which it was used, only 1 showed a permanent decrease; there was no reduction in acidity in 2, with temporary decrease in the other. Vagotomy was followed in 2 instances by pronounced decrease in output of acid and healing of the ulcer. In 2 patients in which vagotomy was incomplete, gastric secretion was not permanently reduced and ulcers recurred.

There was prompt healing of the ulcer whenever gastric acidity was markedly reduced by any means. In one patient resection of three-fourths of the stomach was ineffective in overcoming hypersecretion of acid.

Five figures, including 25 roentgenograms; 5 tables.
G. REGNIER, M.D.
University of Arkansas

Total Teleroentgentherapy in the Acute Form of Malta Fever. André Denier. J. de radiol. et d'électrol. **29:** 662, 1948. (In French)

Total teleroentgentherapy is useful in cases of acute brucellosis—whether due to *B. melitensis* or *B. abortus*—in which the infection has occurred during the preceding weeks or months and fever, palpable lymph nodes, sweats, asthenia, and weight loss persist. On lesions in the joints, bones, and serous surfaces, the action is very inconstant.

The irradiation should be of the total-body type. The average dose is 40 to 50 r (300 kv., 240 cm. distance; 10/10 copper filtration). A second treatment is given eight days after the first, and a third, if necessary, on the sixteenth day. Thirty-three cases have been treated successfully since 1934.

The action of the roentgen rays is explained by an alteration of the "interior milieu" as witnessed by modification of the blood *p*H, cellular permeability, and erythrocyte sedimentation rate, which returns to normal in fifteen to twenty days.

CHARLES NICE, M.D.
University of Minnesota

Physical Problems of Deep Roentgen Therapy. Georg Fuchs. Radiol. Austriaca **1:** 85–104, 1948. (In German)

The conceptions of surface dose, depth dose, half depth, and volume dose are discussed in relation to absorption and scattering of x-rays.

A new method for determining absorption and scattering of roentgen rays in bony tissue was developed by the author. It was found that even when radiation of 80 kv. without filter is used, more than 50 per cent of the rays penetrate the bone. The author found furthermore that the iliac bone of an average adult absorbs about 20 per cent of the rays of a half-value layer of 1 mm. of copper, a fact which needs consideration in the treatment of pelvic diseases and cancer.

It is possible to analyze the intensity of a given x-ray beam into primary radiation and scatter. The additional dose due to scatter appears to be larger than usually accepted. With radiation of 1 mm. copper half-value layer, it was found to be 110 per cent with a 10 × 15 cm. field at a depth of 7.5 cm. With radiation of a half-value layer of 0.95 to 1.5 mm. copper a change of filter from 0.5 mm. copper to the Thoraeus filter means improvement only where bones are penetrated, but not where soft-tissues alone are concerned.

The importance of the Compton effect for depth dose is stressed, as well as the existence of multiple scattering. This softening of the x-ray beam with increasing depth makes a deeply situated bone absorb more radiation than it would on the surface of the body.

Some practical examples illustrate calculating dosage by mathematical means.

Thirteen charts; 12 tables.

H. W. HEFKE, M D.
Milwaukee, Wis.

New Technic and Clinical Results of Plesiotherapy (Contact Therapy). Mario Ponzio. J. de radiol. et d'électrol. **29:** 572–578, 1948. (In French)

The author calls attention to the fact that the majority of the physical, biological, and clinical studies of contact therapy during the past decade are based essentially on experiences with the Chaoul tube. He discusses the construction of contact therapy apparatus, along with the physical and biological principles involved in its use, and describes the equipment which he had constructed for his own use. His apparatus includes an anteriorly situated cathode.

From collected reports some data are assembled which suffice to define the actual state of the knowledge of therapy of contact type. The Philips apparatus represents a remarkable advance in therapeutic radiology, permitting an increased dose to the immediate zone of the lesion, proportional to the desired effect, while respecting the integrity of the surrounding healthy tissue. The biologic reaction of isolated irradiated cellular elements does not differ essentially for different wave lengths in doses of equal quantity. In therapy involving shorter wave lengths, secondary absorption affects tissue reaction more than primary local absorption.

The author has had ten years experience with contact therapy in dermatologic lesions, cutaneous cancer, and even some endocavitary conditions. Above all, lupoid manifestations have appeared to be particularly favorable for contact therapy. Carcinomas and angiomas respond favorably, even in the areas of the eyelid, nose, and inner surface of the lips. Chronic radiation dystrophies and ulcerations have also been treated successfully. Endocavitary therapy has proved quite successful in the mouth, vagina, and rectum. Some rectal carcinomas have disappeared under treatment, but recurrence is common.

Five illustrations.

CHARLES NICE, M.D.
University of Minnesota

Cineradiotherapy. J. Jalet. J. de radiol. et d'électrol. **29:** 583–588, 1948. (In French)

Cineradiotherapy, born of cineradiography, is a method of irradiation of the organism *in toto* or over large fields. The author has studied the principle since 1931. The cutaneous surface is irradiated by an oscillating tube, with short distance and long wave lengths. The bottom of the tube encasement contains a lead screen with a circumferential slit so that the rays may strike the skin at the same angle at all points as the tube moves back and forth.

The author states that the cytocaustic effect is not the only effect to consider in radiation therapy. Stroma reaction, antibodies, humoral mechanisms, and anticancer immunity (observed in man and animals) all play a part in general body defense.

Cineradiotherapy finds its optimum indications in neuro-endocrine affections, neuro-vegetative disturbances, skin infections, and infections in general. It should be employed by preference when one desires functional anticancer radiotherapy.

Seven illustrations.

CHARLES NICE, M.D.
University of Minnesota

RADIOACTIVE ISOTOPES

Radio-Isotopes: Their Production and Uses. C. E. Eddy. M. J. Australia **2:** 537–539, Nov. 6, 1948.

Some Uses of the Artificial Radioactive Elements for Investigation and Treatment. R. Kaye Scott. Ibid. pp. 539–545.

These two papers are rather general reviews of the physical aspects of radioisotopes and their application to research and therapy. Scott bases his discussion largely upon observations made in the course of visiting various clinics in America and Great Britain. No new material is included.

A Method for the Determination of the Radiation Dose Produced by Artificial Radioactive Substances in Tissue. T. Wahlberg. Acta radiol. **30:** 291–298, Nov. 30, 1948.

The use of artificial radioactive substances in medical radiology makes the need for a suitable determination of dosage imperative. At present the activity of these substances is usually given in millicuries, which unit is defined as the quantity of substance in which as many atoms are decomposed per time unit as in that quantity of radon in equilbrium with one milligram of radium. It is desirable, however, that the radiation dose be so expressed as to be easily compared with the roentgen, the unit generally used in radiology. The equivalent roentgen (e.r) has been suggested as a unit of dose determination by Marinelli and others. This is defined as the energy absorbed per gram of air irradiated with a radiation quantity of 1.0 r.

The author describes a method for determination of the radiation dose and radiation activity when the radioactive substance is distributed in the body. The dose at a point within the body is defined by the ioniza-

tion in an air-filled cavity around the point. The ionization measured in electrostatic units per cubic centimeter in a quantity of air at 0° C. and 760 mm. Hg pressure is chosen as a unit for the radiation dose.

The dose rate D within the body is calculated from the formula:

$$D = \frac{J}{V} \cdot K$$

where J is the radiation activity of a radioactive substance, found by means of the product of the radiation dose per second in a water solution of the substance and the volume of the solution; K is a factor comprising the relation between the radiation dose when the substance is distributed in a certain body and the radiation dose when dissolved in water; and V is volume of the body. The biological half life must be considered when calculating the dose.

Measuring apparatus and method of calculation are given and described. The results of measurements on P^{32} are listed in charts and tables.

In radiological treatment where P^{32} is equally distributed in organism or parts of it, the dose rate, allowing for disintegration and excretion of the P^{32}, can be calculated by means of the above formula simplified to:

$$D = \frac{J}{V}$$

Four illustrations; 3 tables. R. A. HAYS, M.D.
Cleveland Clinic Foundation

Radiation Hygiene. Hazards to Physicians, Patients, Nurses, and Others from Use of Radioactive Isotopes. W. Edward Chamberlain, R. R. Newell, Lauriston Taylor, and Harold Wyckoff. J. A. M. A. **138:** 818–819, Nov. 13, 1948.

Radiation hazards can be put into several classes:

A. External irradiation, beta rays, and gamma rays (also roentgen rays). In this group one must consider injury to the patient, injury to the physician and others, injury to casual personnel.

B. Internal irradiation, alpha, beta, and gamma rays. This includes general overdosage; bad distribution leading to local overdose; pick-up of isotopes by physicians and others by means of inhalation, ingestion, absorption through unbroken skin, and through cuts or abrasions; escape of radioactive materials from control, with later pick-up by men, animals, or plants.

External irradiation from isotopes will seldom endanger the patient, who is usually only briefly exposed; the danger is to the doctor and his associates, who are working with these things all the time.

The great hope for the future of isotopes in therapy is the ability of some of them to concentrate in an organ or tissue. This is at the same time a great hazard, for precise dosage depends on precise estimate of how large a volume of tissue will be holding the dose given when it has become concentrated. The effect depends on its specific concentration.

The millicurie is a disintegration rate and so the biologic dose depends on how long the irradiation lasts.

Radium, plutonium, and strontium are carcinogenic, having long physical half-lives, and lie locked up in the bones with very slow excretion. Two micrograms of radium can kill in seven years.

With radium, one fears lest one lose it; with radioisotopes one ought to fear lest one spill it. One leaves gamma rays behind when one quits the room. When a beta ray emitter is spilled on the fingers, the operator carries with him what he cannot wash off. Moreover, beta rays, being highly absorbable, are biologically extremely effective.

It is a heavy responsibility to see that nothing "hot" is re-used and that no dangerous quantities of radioactivity find their way into the sewer or to an open incinerator or dump. Algae especially, but also higher plants, are capable of reconcentrating some elements, so that mere dilution cannot be depended on for safety. Wet and dry radioactive wastes should be collected and isolated, perhaps by deep burial.

S. B. FEINBERG, M.D.
University of Michigan

Determination of Circulating Red Blood Cell Volume with Radioactive Phosphorus. Robert T. Nieset, Blanche Porter, W. V. Trautman, Jr., Ralph M. Bell, William Parson, Champ Lyons and H. S. Mayerson. Am. J. Physiol. **155:** 226–231, November 1948.

A method for the direct measurement of total circulating red blood cell volume by an isotope dilution technic using radioactive phosphorus is presented. The red cells from the subject of the study are utilized for labeling. Rapid uptake and slow release of radioactive phosphorus by exposed red cells facilitates wide experimental application. Ease of counting and the opportunity for repetitive measurement are other advantages.

One graph; 1 table.

RADIATION EFFECTS; EXPERIMENTAL STUDIES

Radiation Injuries Produced by Contact Roentgen Therapy. Erik Poppe. Acta radiol. **30:** 365–370, Nov. 30, 1948.

The authors have used the Philips contact-therapy apparatus with a target-skin distance of 18 mm. and inherent filtration of 0.2 mm. Al (or 20 mm. distance with additional filtration), operated at 2.0 ma. and 50 kv. Without additional filtration, and a distance of 18 mm., the dose at 5 mm. depth is calculated at 40 per cent, and at 10 mm. at 20 per cent of the surface dose. With additional filtration of 1.0 mm. Al, and 20 mm. distance, the depth dose at 10 mm. is 30 per cent of the surface dose. In the period 1944–47, 1,384 patients, were treated, of whom more than 1,300 had benign lesions.

Seventeen patients, all of whom had received treatment to the dorsal surfaces of the fingers or toes, showed rather serious reactions. The areas treated were swollen and tender for several months, and in a few instances ulcerations appeared. Treatment with mild ointments, and sometimes sulfonamides, was helpful in these cases, but in all slight injuries to the skin remained.

There were, in addition, 7 cases of definite radiation injury. In 2 cases of squamous-cell carcinoma of the face and ear receiving 5,000 and 11,000 r, respectively,

without added filtration, post-irradiation ulcers developed. In 4 of the other 5 cases (1 seems to have been unintentionally omitted), the treatments were given to the dorsum of the fingers or toes for warts or clavus. The doses used in the four cases were: (1) 5,000 r without additional filtration to a single field in one stage; (2) 4,000 r with 1.0 mm. Al additional filtration to a single field in two stages; (3) 3,000 r with additional filtration of 1.0 mm. Al to a single field in one stage; (4) 5,000 r to each of seven areas and 3,000 r to each of seven additional areas without supplementary filtration.

It is concluded that the use of contact therapy on the hands and feet demands special precautions. It should be applied without additional filtration, should be fractionated, and special attention should be paid to after care.

R. E. WISE, M.D.
Cleveland Clinic Foundation

Surgical Repair of Irradiation Defects. David W. Robinson. J. Kansas State M. Soc. **49:** 456–461, November 1948.

This article describes the serious injuries which may result from irradiation whether due to accidental overexposure or heroic therapy for cancer. The damage to various types of tissue resulting from x-ray or radium therapy is discussed, including a description of the pathological changes. The etiology of irradiation defects is classified as follows: (1) accidental x-ray burns of physicians; (2) injury from intentional massive dosage for neoplasm; (3) late change from repeated small dosage given for superficial therapy; (4) burns to patients from prolonged exposure under the fluoroscope.

The underlying principles of surgical treatment in all types of cases are the same, namely, the removal of the damaged structures and coverage with viable tissue. The actual surgical technic depends upon the extent of damage and its location on the patient's body.

The author presents 4 cases representing the four types of etiology and the various methods which may be used in dealing with this type of injury. Special warnings are emphasized concerning the frequency of malignant change and of stubborn infections in irradiated tissues.

Five photographs.

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Relation of Radiosensitivity and Radiocurability to the Histology of Tumour Tissue. A. Glücksmann. Brit. J. Radiol. **21:** 559–566, November 1948.

It is well recognized that radiosensitivity does not always mean radiocurability and *vice versa*. The author has analyzed in a succinct manner some of the factors affecting this paradox.

Radiosensitivity is defined as the quality of a tumor which allows rapid diminution of size after a relatively small dose of radiation. This quality depends upon the natural life span of the tumor cells, the form and extent of necrosis produced, and the ability of the tumor bed to absorb necrotic material. Tumors with cells of normally short life will regress rapidly after irradiation. Tumors containing cells which die rather than differentiate will regress more rapidly; yet these tumors may not be so radiocurable.

Radiocurability is defined as the five-year absence of tumor symptoms in the area treated. This is governed partly by accessibility—the more accessible the more curable. Size also is a factor: the larger, while not necessarily the older, the less curable. The growth rate is important; the more rapidly growing tumors, usually found among the more anaplastic tumors, are the less curable.

The final important factor is the tendency to metastasize. The increased resistance of metastatic lesions in lymph nodes is probably due to the biological characteristics of the tumor rather than to an increased resistance due to metastasis.

Eight graphs; 2 tables.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

The Spleen as Indicator of Different Biological Roentgen Effects. R. Pape and N. Jellinek. Radiol. Austriaca **1:** 59–76, 1948. (In German)

Experimental total body irradiation on rats was used to examine the effect of different dosage on the spleen. Destructive changes with massive nuclear destruction were found with high dosage; predominantly degenerative changes with doses down to between 25 and 50 r. With doses of 20 r and less, especially repeated small doses, changes were seen which suggested reactive processes in the lymphatic and reticulo-endothelial system, but no persistent, direct histological changes could be made out. There is no definite sharp borderline between these stages of tissue reaction.

After destructive but non-lethal doses, the authors found that the lymphoblasts were the first lymphatic cells to be destroyed; forty-eight hours after such irradiation the shrunken follicles contained predominantly lymphocytes.

The histologic appearance changes when regeneration takes place. The follicle is smaller than normal, its center is relatively large, and there is only a narrow circle of mature lymphocytes surrounding it; the capsule shows spindle-shaped cells and around it are some epithelioid cells. This capsule, which normally forms a part of the follicle, becomes more prominent after irradiation.

Regenerative processes in the follicle can be slowed down by small fractionated doses of x-rays; such fractionation is more effective in that respect than a single larger dose.

It seems possible to explain the reactive phase after irradiation on the basis of an activation of the reticulo-endothelial system.

Thirteen photomicrographs.

H. W. HEFKE, M.D.
Milwaukee, Wis.

Effects of X-Ray on Lymphoid and Hemopoietic Tissues of Albino Mice. G. Brecher, K. M. Endicott, H. Gump, and H. P. Brawner. Blood **3:** 1259–1274, November 1948.

Quantitative myelograms, peripheral blood counts, and the histologic appearance of lymphoid tissues were studied in albino mice of the CFW strain during a period of four weeks following a single whole body irradiation with 400 r measured in air (186 kv., 20 ma., at 50 cm. with 0.25 mm. copper and 0.55 mm. aluminum filtration, for 6.24 minutes). All animals survived the period of the experiment without obvious illness.

Nucleated red blood cells disappeared almost completely from the marrow within twenty-four hours after irradiation. Regeneration of the erythroid series

began around the seventh day. Only mild to moderate anemia developed, presumably due to the longevity of red blood cells.

Suppression of mitotic activity and diminution of the myeloid marrow was marked during the first week after irradiation. Granulocytopenia in the peripheral blood was severe for only a very short period. Early damage to the lymphoid tissue was more pronounced and lymphopenia was of longer duration than granulocytopenia in spite of early regeneration of the lymphoid issues. Differences in the relative amount of damage to lymphoid and myeloid tissues and in their rates of regeneration were not of sufficient magnitude to indicate a truly selective damage to the lymphoid tissues under the conditions of the experiments.

No morphologic evidence of damage to the reticuloendothelial system was found. The possible use of irradiated animals for functional studies of the lymphoid apparatus is discussed.

Thirteen photomicrographs; 4 tables.

Increased Tolerance of Mice to a Lethal Dose of X-Ray Radiation as a Result of Previous Sublethal Exposures. Eugene P. Cronkite, Clyde R. Sipe, Dean C. Eltzholtz, William H. Chapman, and F. W. Chambers, Jr. Naval Medical Research Institute, Project NM 007 039, Report No. 15, Aug. 17, 1948.

An experimental attempt was made to alter the lethality of total-body exposure to x-rays by previous fractional exposure to sublethal whole-body irradiation. Three groups of 100 mice each were irradiated. Group 1 received no preliminary irradiation. Groups 2 and 3 each received a sublethal dose of 144 r at weekly intervals for three weeks. Thirty days after the third weekly dose, Group 3 was given a lethal-range dose of 703 r. At the same time the previously unirradiated mice of Group 1 received a similar dose.

There were no deaths among the mice receiving only the preliminary irradiation (Group 2). The twenty-eight-day mortality in Group 1 was 41 per cent, and in Group 3 was 26 per cent. This difference is considered statistically consistent, indicating that the resistance of the animals was increased by the earlier sublethal exposures.

No adequate explanation for this increased tolerance is at present available. The authors find it difficult to assume an actual increase in cellular resistance to irradiation. They believe a more plausible explanation to be that the sublethal exposures increased the nonspecific resistance as defined by Selye (J. Clin. Endocrinol. **6:** 117, 1946) or perhaps increased the specific resistance through the development of protective antibodies against the products of cellular destruction.

One table. S. F. THOMAS, M.D.
Palo Alto, Calif.

Failure of Rutin to Decrease the Mortality of Acute Ionizing Radiation Illness in Mice. Eugene P. Cronkite, Dean C. Eltzholtz, Clyde R. Sipe, William H. Chapman, and F. W. Chambers, Jr. Naval Medical Research Institute, Project NM 007 039, Report No. 16, Aug. 19, 1948.

Rutin in an amount adequate for most clinical purposes was not only of no value in improving the survival of mice exposed to a dose of ionizing radiation in the lethal range, but significantly increased the rate at which the mice died. The mortality among 99 mice receiving rutin was 52.5 per cent, while that in a control series was 40.6 per cent.

Rutin has been reported clinically to have a favorable effect on capillary fragility. Since this effect has been found to be less marked in the presence of vitamin C deficiency, it is suggested that it might be well to repeat these experiments on animals, such as guinea-pigs, whose dietary requirements in this respect more closely resemble those of man. (Mice do not require vitamin C in the diet.) It is pointed out, however, that many factors influence survival following exposure to radiation and that capillary integrity may not be the critical one.

One table; 3 graphs. S. F. THOMAS, M.D.
Palo Alto, Calif.

Failure of Folic Acid to Alter the Clinical Course and Hematologic Picture of Fatal Single Total Body Irradiation in Swine. Eugene P. Cronkite, John L. Tullis, Carl Tessmer, and T. W. Ullrich. Naval Medical Research Institute, Project NM 007 039, Report No. 18, Sept. 30, 1948.

Eight adult swine received 400 r total-body irradiation by 1,000 kv. x-rays. Beginning on the following day, folic acid was administered intramuscularly to 4 of the animals in doses of 45 mg. daily until their death. The clinical and hematologic courses and autopsy findings were not significantly affected by this latter treatment.

One table; 2 figures. S. F. THOMAS, M.D.
Palo Alto, Calif.

A Method for the Simultaneous Exposure of Large Numbers of Animals to Single Dose High Intensity Total Body X-Ray Radiation. William H. Chapman, Clyde R. Sipe, D. C. Eltzholtz, Eugene P. Cronkite George H. Lawrence, and F. W. Chambers, Jr. Naval Medical Research Institute, Project NM 007 039, Report No. 14, Aug. 12, 1948.

This paper shows how large numbers of animals of different species can be given total-body irradiation simultaneously from a 1,000-kv. industrial x-ray tube. This is accomplished by disposing the animals in a circle of 1 meter radius about the tube, at the point of maximum radiation intensity. By this method the numerous extraneous factors which may influence the mortality from radiation sickness are neutralized and controlled.

The authors show ingenuity in the design of the animal cages, each of which conforms to a segment of the arc of the circle. Specifications for their construction are furnished and a diagram is shown illustrating the geometric relationship of the x-ray tube to the cages.

Four photographs; 1 diagram.
S. F. THOMAS, M.D.
Palo Alto, Calif.

A Preliminary Note on Some Biological Effects of Alpha Radiation on the Frog Tadpole. K. Tansley, L. H. Gray, and F. G. Spear. Brit. J. Radiol. **21:** 567–570, November 1948.

Studies of counts of mitosis and degenerating cells in brain and eye tissue of the frog tadpole exposed to alpha radiation, similar to studies previously reported for gamma radiation (Brit. J. Radiol. **14:** 65, 1941. Abst. in Radiology **37:** 658, 1941) were made.

At low doses of alpha radiation the effects were com-

parable with those of gamma rays, showing an immediate decrease in mitosis and an increase in degenerating cells. With larger doses the number of degenerating cells was enormously greater after alpha radiation.

Four graphs; 3 tables. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Tolerance of Cerebral Blood-Vessels to a Contrast Medium of the Diodrast Group. An Experimental Study of the Effect on the Blood-Brain-Barrier. Tore Broman and Olle Olsson. Acta radiol. **30**: 326–342, Nov. 30, 1948.

Clinical experience has shown that contrast media of the diodrast group (perabrodil, diodrast, umbradil, dijodon), especially when used in high concentrations, may cause cerebral symptoms. The authors, assuming that these cerebral symptoms followed damage to the normal blood-brain barrier, undertook a study of the permeability of the cerebral vessels in the rabbit, cat, and guinea-pig.

The experiments revealed that 50 per cent concentrations of contrast medium injected for ten or more seconds as a rule disturbed blood vessel permeability. With concentrations above 50 per cent, disturbed permeability could be demonstrated after an injection of two seconds. Damage to the blood-brain barrier was accompanied by disturbances in cerebral function. Moderate disturbance of permeability was reversible within two hours.

The following tentative conclusions are reached: (1) 35 per cent concentration of contrast medium is recommended for injections into the vertebral artery and internal carotid artery, but in exceptional cases a small amount of 50 per cent solution may be used for one injection; (2) 35 per cent concentration is suggested for percutaneous injections into the common carotid artery, and if films prove that the needle was in the common carotid artery, a second injection of 50 per cent medium may be used; (3) regardless of the concentration, the injection time should be short and the number of injections should be limited. The general use of thorotrast as a contrast medium for cerebral angiography is held to be indefensible.

Three illustrations, 2 in color.

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